ECB communication and its impact on financial markets

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Abstract

This paper introduces the Euro Area Communication Event-Study Database (EACED), a new dataset tracking intraday financial market movements around 304 ECB Governing Council meetings (ECBGC) and 5,100 inter-meeting communication (IMC) events by GC members, primarily in the form of speeches and interviews. We document that IMC events are associated with significant market movements often comparable to, or larger than, those following ECB policy announcements, particularly for longer maturity yields. Importantly, these effects are not limited to communication from the ECB President but also from other Governing Council members. Like ECBGC announcements, IMC events convey multidimensional information: three structurally identified factors explain a large share of the yield curve movements around IMC surprises. Finally, we show that IMC events provide relevant information for identifying the effects of monetary policy shocks on euro area output and inflation in a Bayesian Vector Autoregression model.

Keywords: Monetary policy, ECB, high-frequency identification, communication, financial markets, euro area.
JEL codes: E50, E52, E58, E61.

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1 Introduction

ECB Governing Council (ECBGC) monetary policy announcements move financial markets. However, these announcements account for only a fraction of ECB GC members' communication, as a substantial share takes place between meetings through speeches, interviews, and other public appearances. While inter-meeting communication (IMC) of ECB GC members does not entail formal decisions, it can move markets by revealing signals about future actions or their reaction function.[1] This paper examines market reactions to both ECBGC meetings and IMC events, offering a comprehensive analysis of how inter-meeting communication influences financial markets and the transmission of monetary policy in the euro area.

Our contribution is three-fold. First, we construct the *Euro Area Communication Event-Study Database* (EA-CED), which consists of 304 ECBGC meetings and approximately 5,100 IMC events from GC members and the respective intraday changes of 47 euro area financial variables around these events, from January 1999 to February 2024. IMC events include speeches and interviews given by ECB Presidents, members of the ECB Executive Board, the Governors of the French, German, Italian, and Spanish national central banks, as well as the publication of the ECB Monetary Policy Accounts. High-frequency changes around ECBGC communication are based on an event study, in the spirit of Kuttner (2001); Gürkaynak et al. (2005b), measuring price changes of assets in a narrow time window around these events. Importantly, in the EA-CED we differentiate between events that do and do not move markets significantly, based on their impact computed relative to the market volatility prior to the event. Overall, there are about 2,600 IMC events and 280 ECBGC policy meetings that we classified to carry significant news - about 60% of the total events in the EA-CED. We made this database publicly available for researchers.

As a second contribution, we document that Eurosystem inter-meeting communica-

[1]The importance of IMC grew more after the ECB adopted forward guidance in 2013 and introduced measures targeting the long end of the yield curve, both requiring frequent and detailed communication beyond ECB GC meetings. This trend is not unique to the ECB. Blinder et al. (2017) show that over 90% of central bank governors in advanced economies increased communication after the financial crisis.

tion has a considerable impact on euro area financial assets, often of similar or larger magnitude than ECB policy announcements, particularly for medium- and long-term interest rates. The significant impact is not limited to communication from the ECB President; other GC members also significantly influence markets. The relevance of IMC is further supported by the evidence that IMC events ahead of monetary policy decisions contain policy signals that move risk-free rates and sovereign yields in the direction of the forthcoming decision (especially ahead of tightening decisions). Moreover, information in IMC is multidimensional in the sense that three structurally identified factors, known in the literature as Target, Forward Guidance (FG) and Quantitative Easing, explain around 90% of the yield curve movements around IMC events. These factors have a similar, though not identical, impact to those extracted from ECBGC announcement surprises.[2]

As a third contribution, we show how the EA-CED - specifically, IMC surprises - can be used to identify the effect of monetary policy shocks on macroeconomic variables in the euro area. We construct narrative sign restrictions (NSR) (Antolín-Díaz and Rubio-Ramírez, 2018) based on the structural IMC factors (Target and FG) and implement them in a Bayesian Vector Autoregression (BVAR) model in combination with minimal traditional sign restrictions on the response of the risk-free rate and of the stock market. Compared to identification based solely on sign restrictions, the IMC-based NSR approach yields markedly improved results, with estimated responses of real GDP and consumer prices that are both significant and do not exhibit the prize puzzle, underscoring the informational value in inter-meeting communication. A BVAR model with narrative restrictions based on Target and FG factors from ECBGC meetings produces very similar responses, though with less precision. To the best of our knowledge, this is the first evidence that few IMC events alone can identify the impact of monetary policy shocks in the euro area.

We contribute to a large literature that studies the role of central bank communication for movements in financial markets. Our work most closely relates to Brand

[2]These findings are based on using a factor model as in Swanson (2021) which projects yield curve movements around IMC (ECBGC) events onto a lower-dimensional space of structural shocks.

et al. (2010), Altavilla et al. (2019), Swanson (2023), and Swanson and Jayawickrema (2024). Brand et al. (2010) and Altavilla et al. (2019) construct datasets of intraday asset price movements around ECBGC meetings and analyze the structural shocks driving these market reactions.[3] Our paper extends their work and provides new results in several dimensions. First, we compile a comprehensive database covering both ECBGC meetings and Eurosystem IMC events, and provide a detailed analysis of their impact across different types of communication, speakers, asset classes, and over time. Second, we assess whether ECBGC and IMC events have a statistically significant impact on financial variables, highlighting the importance of accounting for market volatility, as not all events lead to meaningful market movements. Moreover, we demonstrate that surprises around IMC and ECBGC events can be used to identify monetary policy shocks within a BVAR with narrative restrictions. Our results are in line with Swanson (2023) and Swanson and Jayawickrema (2024), who show that speeches by the Fed Chair are as important as FOMC policy announcements for market movements in the U.S.

Gürkaynak et al. (2005a), Altavilla et al. (2019), and Swanson (2021) decompose the multi-dimensional yield curve surprises around monetary policy announcements and IMC into a smaller number of structurally interpretable components. We show that yield curve surprises caused by IMC events in the euro area can be explained by a similar factor structure, suggesting that inter-meeting communication largely reflects the ongoing conduct of monetary policy. This result aligns with the findings of Swanson and Jayawickrema (2024) that speeches by the Fed Chair and Vice-Chair exhibit the same factor structure as FOMC policy announcements.

Regarding the macroeconomic effects, our work is closely related to Jarociński and Karadi (2020) and Badinger and Schiman (2023), who use a BVAR to estimate the impact of monetary policy shocks in the euro area and base their identification on surprises around ECBGC announcements. We show that an identification strategy

[3] Ehrmann and Fratzscher (2007) provided an early study measuring IMC via reports in *Reuters News* but did not study the intraday variation around the events. Ehrmann et al. (2023) look at the financial market effect of anonymous monetary policy leaks in the euro area, comparing them with effects from attributable statements in the press by ECB policymakers.

based solely on IMC-based surprises leads to estimates of the impact of monetary policy shocks on output and inflation that closely resemble and are more precisely estimated than those obtained using ECBGC-based surprises. In this regard, our findings for the euro area are consistent with those of Bauer and Swanson (2023) for the U.S., who show that surprises around Fed Chair speeches enhance the identification of monetary policy shocks in the U.S.

The remainder of the paper is organized as follows. Section 2 describes the *Euro Area Communication Event-Study Database*. Section 3 presents our event-study methodology and the main results on intraday movements of financial variables around ECBGC meetings and IMC events. Section 4 studies the information content of IMC events and Section 5 presents the results of the BVAR model with narrative sign restrictions. Section 6 concludes.

2 The Euro Area Communication Event-Study Database

To construct the *Euro Area Communication Event-Study Database* (EA-CED), we combine three datasets, labeled *Eurosystem Events*, *Control Events*, and *Financial Markets*. The ***Eurosystem Events*** dataset contains information on the following communication events: (1) ECB Governing Council monetary policy meetings (ECBGC), (2) ECB Monetary Policy Accounts' publication (Accounts), (3) speaking events by ECB Presidents (including hearings at the European Parliament), by ECB Executive Board (EB) members (except the ECB President) and by Bundesbank, Banque de France, Banca d'Italia, and Banco de España governors (NCBs), and (4) interviews from all ECB EB members and our selected NCB governors.

Speaking events outside of ECBGC meeting days, interviews and the publication of meeting accounts, i.e. events falling the category (2) to (4), constitute our sample of Eurosystem inter-meeting communication (IMC). For all events, the database contains the date and the starting time (hour and minute). For speaking events, it additionally contains the title, the speaker's name, and the location of the event. Except for

interviews, our source is the calendar of events in Bloomberg's (BBG) Econ page, for the period January 1999 to February 2024. A typical title in this calendar mentions the name of the speaker and the location of the event, e.g., "ECB's Lagarde speaks in Frankfurt". From the BBG calendar, we selected and classified events as described in *Eurosystem Events* above, for which there is a timestamp, and discarded the rest.[4] We thoroughly cleaned the BBG dataset for reporting errors, such as double entries or events for which the time is clearly misreported. Our source for interviews is Refinitiv Eikon, from which we retrieve the timestamp of the event, the speaker, and the text of the interview when available. In Table A.1 in appendix we report details on the total number of observations, the source, and the sample period for each of these communication events.

One important difference between ECBGC monetary policy meetings and IMC events is that monetary policy is decided only in the former. The ECB Monetary Policy Accounts, published three weeks after the decision, is the information closest in type to an ECBGC announcement as it provides a more detailed account of what was discussed and decided in the meeting; this document is also agreed upon by the Governing Council. In contrast, all other IMC events (speeches and interviews) are not associated with a policy decision and do not necessarily represent the views of the Governing Council. They can also be on topics different from monetary policy, as typically speeches take place in international meetings, academic conferences, or other similar events, of regular or irregular frequency.[5] For example, Parliament hearings are regular events where the ECB President explains the ECB's policy before Members of the European Parliament and answers their questions. The primary objective of this type of communication is to hold the ECB accountable.[6] A key feature of most IMC events is that they give the speaker discretion over the content and, to some extent, reflect debates and opinions that have also been expressed in policy meetings and

[4]The rest of events either lack a timestamp or relate to GC members not included in our list.

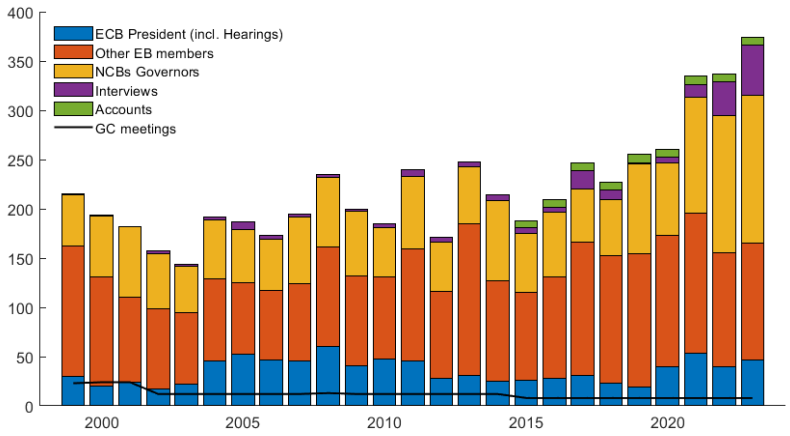
[5]Our approach of assessing the significance of each individual event relative to pre-event market movements allows us to filter out those that may be on topics not relevant for monetary policy.

[6]Using text analysis on the ECB President's introductory statements in parliamentary hearings and press conferences from 1998 to 2021, Fraccaroli et al. (2022) show that the ECB uses parliamentary hearings to discuss topics that are less covered in the ECBGC press conferences.

have guided policy. Many IMC events also receive extensive media coverage, which suggests that they contain "newsworthy" information.

Figure 1 displays how our communication events are distributed over time. On average, our sample contains approximately 220 IMC events per year, compared to 8 (since 2015) ECBGC policy meetings. Over time, the frequency of IMC varies, with peaks in specific periods, as in 1999 with the start of the euro, during the financial crisis of 2007-2008, in 2013 when the ECB introduced forward guidance on interest rates, and in 2021 corresponding with the announcement of the ECB strategy review. We observe that ECB EB members and NCB governors have both increased their speaking engagements over the past decade. The 2022-2023 period is characterized by a marked increase in communication, driven in particular by NCB governors. With regard to ECB Presidents, there is a noticeable fixed effect for speakers, with Wim Duisenerg (1998-2003) and Mario Draghi (2011-2019) displaying fewer speaking events than Jean-Claude Trichet (2003-2011) and Christine Lagarde (2019-current).

Figure 1: ECB/Eurosystem communication events



Note: The figure displays the number of IMC events by the ECB President, including EU Parliament Hearings, the number of speeches by other ECB EB members and by NCBs Governors (BdF, Buba, BdI, BdE), the number of interviews, ECB Accounts' publications and ECBGC monetary policy meetings (black line). All events are displayed at an annual frequency.

The second dataset, ***Control Events***, consists of the date, time, and title of events that inform about the state of the economy and are systematically published: (1) major macroeconomic release for Germany, France, Italy, Spain and the euro area (flash

estimates for real GDP and HICP inflation, unemployment, composite Purchasing Managers' Indices, industrial production flash estimates, and consumer confidence and business climate surveys), (2) selected major U.S. macroeconomic surprises (real GDP growth, CPI, Non-Farm Payrolls and Initial Jobless Claims), and (3) Federal Open Market Committee (FOMC) monetary policy decisions days. The data source is BBG.

If the BBG survey expectation coincides with the actual data release, we exclude the macro-release event from the database, assuming it did not generate a market surprise. However, we retain macro-release events for which survey expectations are unavailable.[7] Section 3 describes how handle these control events when computing surprises around IMC and ECBGC events.

The third dataset, ***Financial Markets***, consists of minute-by-minute bid and ask quotes for the following financial variables: (1) euro area Overnight Indexed Swaps (OIS) with maturities of one month (1M) to 10 years (10Y), (2) sovereign bond yields of Germany, France, Italy, and Spain for maturities of three months up to 10 years, (3) inflation-linked swaps (ILS) with maturities of one, two, five, and 10 years, (4) the Eurostoxx50 index, and (5) the EUR/USD exchange rate.

In our analysis, we use the mid-quote computed as the average of the bid and ask close quotes. Minute-by-minute quotes are obtained from Refinitiv Eikon. Data on OIS rates for maturities between one month and three years begin between 1999 and 2002, while data for longer maturities start in 2011. Eurostoxx50 and EUR/USD quotes are available from 1999 onward, whereas the start date for sovereign yield data depends on the maturity. Table A.2 shows the availability of OIS rates and sovereign yields across maturities. The last observation in our database is February 16, 2024.

The *Eurosystem Events*, *Control Events*, and the *Financial Markets* dataset allow us to construct the ***Euro Area Communication Event-Study Database*** (EA-CED), which contains intraday changes of 47 euro area financial variables around the ECBGC monetary policy meeting and IMC events. Further details on the dataset can be found in the supplementary material.

[7] For the U.S. Non-Farm Payroll data, we consider only those releases for which the actual value relative to the expectation is outside the 25% to 75% quantiles

3 Event-study for Eurosystem communication events

The EA-CED contains the high-frequency changes in asset prices constructed as described in this section. In particular, we compute these changes in a narrow window around central bank communication events, similar to the literature focusing on monetary policy announcements (Kuttner (2001); Gürkaynak et al. (2005a), among others). This literature measures the causal impact of monetary policy announcements as the difference between the asset prices' quotes right before the start of the event and the quotes right after the event. The identifying assumption is that the event window is sufficiently narrow to exclusively contain the event under consideration but large enough to capture the potential effect of the event. Therefore, a crucial element of this event-study strategy is the choice of the length of the event window.

For ECBGC policy meetings, we consider the full monetary policy event window, including both the press release and the press conference. Until April 2022, the ECBGC meeting is followed by a press release published at 13:45 and a press conference with the ECB President at 14:30, including a Q&A with journalists. Since June 2022, these events take place at 14:15 and 14:45, respectively. To construct surprises over the full monetary policy event window, we largely follow Altavilla et al. (2019), the details of which we describe in Appendix B.

For IMC events, determining the appropriate length of the event window is more challenging, as these events vary in content, format and duration, and the information they convey may reach financial markets either immediately or with a delay.[8] For IMC events that are speeches and interviews, we use a 90-minute event window based on our anecdotal evidence on how long it takes for news about an event to be reported..[9] For Parliament hearings, we choose an event window of 180 minutes, reflecting the typically longer duration of these events. For monetary policy meeting accounts, we use a 45-minute window, since the event is the publication of a short

[8]Often, central banks publish the speech on their website immediately, or news wires have received the speech and have it under embargo until the speech starts.

[9]We read news relating to several of the ECB Presidents' events, finding that the majority received a news report immediately or within 1.5 to 3 hours from the scheduled start of the event. The 90-minute window for speeches is also in line with Swanson and Jayawickrema (2024) for Fed Chair speeches.

document published always at the same known time (13:30, CET). Our identifying assumption is that, within the chosen time windows, information from the different IMC events is conveyed to markets. Further, for all IMC events, we set the pre- and post-event windows to 15 minutes, which are standard values in the literature. Concretely, to construct high-frequency price changes around IMC events, we take the difference between the median of the quotes 15 minutes after the end of the event ("post-event window") and the median quote over 15 minutes before the event ("pre-event window"), as illustrated in Figure C.1 in the appendix.

In order to control for the impact of a macro data release that is published during the same time window of an IMC event, we compute the surprise in financial variables associated with the macro-release and subtract it from the IMC surprise. Concretely, the surprise due to a macro data release is computed as the difference in the median of the quotes in the 10-minute window after and prior to the release event, with the event window set to five minutes. Consider the example of an IMC event starting at 12:00 and a macro-release scheduled at 12:30. Then, for a given financial variable, we compute the macro-release surprise by taking the difference of the median quote from 12:35 to 12:44 and the median quote from 12:20 to 12:29 and subtract this from the surprise that we compute for the specific IMC event.

Furthermore, we exclude speeches that take place on Saturday or Sunday, as the time window between the close of the markets on Friday and the opening on Monday is too long to justify the rationale for high-frequency identification. Overall, there are about 5,100 IMC events for which we compute asset price changes. This number changes between financial instruments due to different sample starting dates and/or the availability of minute-by-minute quotes in the selected windows. In addition, we further clean the database by identifying 39 IMC events for which we either excluded the change for a specific asset, due to misquotes in the underlying minute-by-minute data, or excluded the entire event if it overlaps with another known major event, such the Brexit referendum vote.

3.1 Abnormal market reactions around communication events

This section describes the methodology that we use to evaluate whether high-frequency movements constitute abnormal market changes, based on the event-study approach of MacKinlay (1997). This amounts to estimating the intraday variance of the process on data until the event occurs and then, based on the pre-event intraday variance, constructing prediction intervals for the event window length. The prediction interval provides a measure of how much of a price change could have been expected over the respective event window based on the asset's intraday variance present prior to the event. This procedure allows us to assess whether asset price changes around communication events are abnormal - that is, statistically significantly different from zero. To simplify the jargon, we label all abnormal market changes as abnormal *returns* even though for rates we use the difference in bps.

Following MacKinlay (1997), let the interest rate in basis points (value of the stock index in natural logarithm) on a given day be denoted by X_t and

$$\mathrm{Y}_{t_1} = X_{t_1} - X_{t_0}, \tag{1}$$

where Y_{t_1} denotes the interest rate change (return in the case of the stock index) over a given event, where t_0 is the start and t_1 the end of the event.

Under the null hypothesis that the event has no impact on the interest rate (asset price) and given a distributional assumption on the process of X_t, specified below, $\mathrm{Y}_{t_1} \sim N(\mu_{t_1}, \mathrm{var}(\mathrm{Y}_{t_1}))$, where μ_{t_1} denotes the predicted mean and $\mathrm{var}(\mathrm{Y}_{t_1})$ denotes the variance of the interest rate change (asset price return) over the respective event window. Testing the null hypothesis requires an estimate of the predicted mean, μ_{t_1}, and the variance $\mathrm{var}(\mathrm{Y}_{t_1})$. We follow Aït-Sahalia et al. (2005), which allows for the data to be sampled at discrete non-equidistant time intervals and allows for, but does not impose, the potential presence of market microstructure noise, and model X_t as a Brownian motion (without drift). This allows us to estimate the variance of the process up to the event. Given these estimates, we test the null hypothesis of no abnormal

return by computing the out-of-sample predictive intervals at a 90% confidence level. Section C.1 provides further details on the estimation.

3.2 Estimates of abnormal market reactions

Figure 2 illustrates OIS1Y movements around selected IMC events from different Governing Council members that led to abnormal returns.[10] The shaded areas show the predictive bands for minute increments of the predictive horizon, i.e., the one-minute-ahead up to 90-minute-ahead prediction interval.

On November 18, 2005, OIS1Y jumped during the speech of ECB President Trichet. NYT (2005) writes: "ECB made it clear it will raise rates. [...] “We will remove some of the accommodation which is in the present monetary policy stance,” Trichet said [...]".

In contrast, the OIS1Y falls during the speech of ECB President Mario Draghi on June 18, 2019. SNBC (2019) writes: "Speaking at the ECB Forum in Sintra, Portugal, Draghi gave a defiantly dovish tone, saying that if the economic situation deteriorates in the coming months the bank would announce further stimulus. The euro dropped 0.2% against the dollar in a matter of minutes as Draghi delivered the remarks. The German 10-year bund yield hit -0.30% for the first time ever."

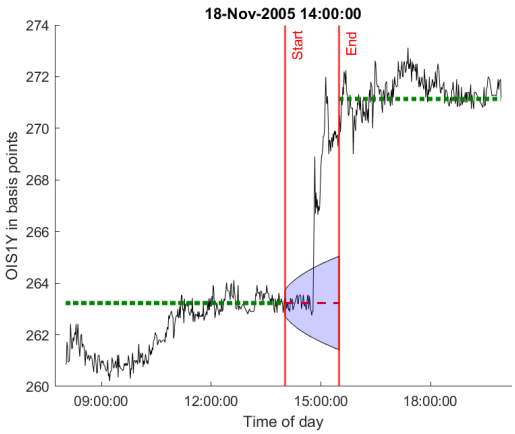
One year after the start of the past ECB tightening cycle, the OIS1Y fell during the speech of Francois Villeroy de Galhau on June 1, 2023. Reuters (2023) comments on the message of the speech as follows: "The increases in interest rates that we still have to do are relatively marginal, most of the work has been done," said Villeroy, who was speaking at an event hosted by various French media organizations and the Toulouse School of Economics." More recently, on 10 January 2024, the OIS1Y jumped during the live interview of Isabel Schnabel on Twitter. Weber and Schroers (2024) write on Bloomberg: "ECB’s Schnabel Says Too Early to Discuss Interest-Rate Cuts".

Table 1 shows the number of events that led to an abnormal return on the OIS rates and the Eurostoxx50.[11] The numbers in parentheses indicate the percentage of

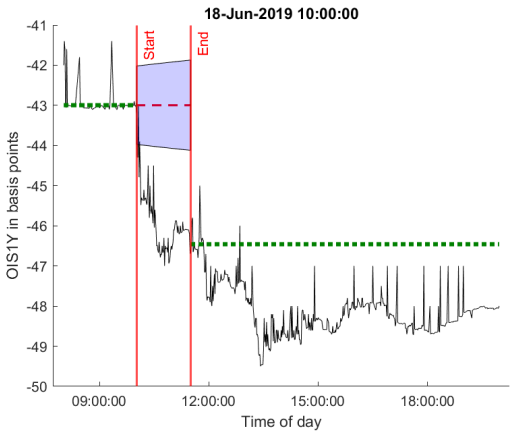
[10] Figure F.1 in the appendix shows examples of ECBGC meetings and IMC events with returns that are not classified as abnormal.

[11] Table F.2 in the appendix shows an analog version of Table 1 for the case of using a fixed threshold

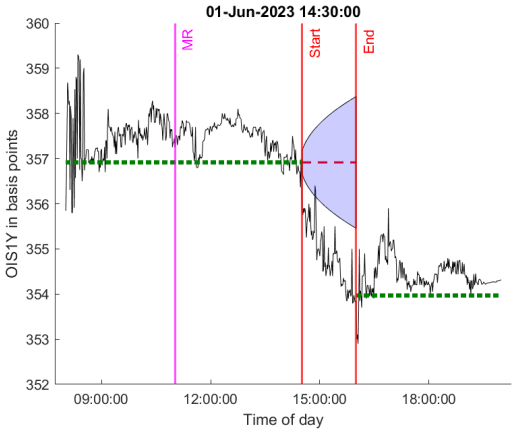
Figure 2: Examples of the effects of inter-meeting communication on OIS1Y



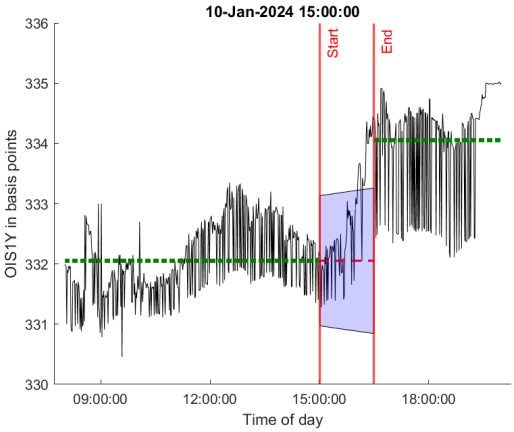
(a) ECB: J.-C.Trichet, Nov. 18, 2005



(b) ECB: M. Draghi, June 18, 2019



(c) NCB: F. Villeroy de Galhau, June 1, 2023



(d) ECB: I. Schnabel, Jan. 10, 2024

Note: The solid line shows the minute-by-minute quotes of the OIS1Y in bps. The vertical lines with the labels "Start" ("End")show the start (end) of the 90-minute IMC event window. The vertical lines with the label "MR" show macro-releases. The dashed lines show the median of the quotes in the 15-minute pre-event window and the 15-minute post-event window, respectively. The shaded areas show the predictive intervals based on the intraday variance estimated on data up to the event.

events with an abnormal return relative to the total number of communication events for which we can compute a market reaction for this asset. The share of IMC events that cause abnormal returns increases along the OIS maturity structure, whereas the share of ECBGC events has a hump shape. We observe indeed that about half of the ECBGC meetings lead to abnormal returns on the OIS1Y and OIS2Y; for shorter or longer maturities this number is considerably smaller. This result suggests that not all

of a minimum 3 bps change to distinguish relevant from non-relevant events, as in Swanson (2023). We find that more events would be dropped as insignificant compared to our approach. However, as Figure C.2 in the appendix demonstrates, there are periods during which the market volatility is low and movements smaller than 3 bps could be considered abnormal.

Table 1: Number of communication events that lead to abnormal returns

	OIS									Eurostoxx50
	1999-2024					2002-2024	2011-2024			1999-2024
Events	1M	3M	6M	1Y	2Y	3Y	5Y	7Y	10Y	
ECBGC	104	125	138	147	143	113	71	65	68	117
	(34 %)	(41 %)	(45 %)	(48 %)	(46 %)	(37 %)	(23 %)	(21 %)	(22 %)	(38 %)
ECB Pres.	19	32	38	55	67	52	41	44	42	81
	(3 %)	(4 %)	(5 %)	(8 %)	(10 %)	(8 %)	(12 %)	(13 %)	(12 %)	(11 %)
ECB EB	61	91	98	137	166	170	126	130	149	263
	(2 %)	(4 %)	(4 %)	(5 %)	(7 %)	(8 %)	(9 %)	(9 %)	(10 %)	(11 %)
NCBs	54	66	87	126	136	136	100	104	105	150
	(3 %)	(4 %)	(5 %)	(8 %)	(8 %)	(9 %)	(10 %)	(11 %)	(11 %)	(9 %)
EP hearing	3	4	11	11	18	14	4	4	3	11
	(3 %)	(3 %)	(9 %)	(9 %)	(16 %)	(14 %)	(8 %)	(8 %)	(6 %)	(9 %)
Accounts	2	1	5	5	4	6	10	12	14	10
	(3 %)	(1 %)	(7 %)	(7 %)	(5 %)	(8 %)	(14 %)	(16 %)	(19 %)	(14 %)
Interviews	5	10	9	25	29	18	19	23	25	14
	(3 %)	(5 %)	(5 %)	(14 %)	(16 %)	(10 %)	(13 %)	(16 %)	(17 %)	(8 %)

Note: For each event type, the first row shows the total number of events with abnormal returns and the second shows the events with abnormal returns as a percentage of all events for which we can compute price changes for the respective asset. ECBGC refers to ECB GC monetary policy meeting events. Rows from ECB President to EP hearing, refer to IMC events from ECB Presidents, the ECB Executive Board (EB) members, the governors of the NCBs of Germany, France, Italy, and Spain, and the European Parliament (EP) hearings of the ECB President. Accounts refers to the publication of ECB Monetary Policy Accounts and Interview to the publication of interviews of our selected GC members.

ECBGC meetings lead to relevant market movements.Interest rate changes around GC meetings are often used as instruments to identify the impact of monetary policy on the macroeconomy in VARs or local projections regressions. Results in Table 1 suggest that a high percentage of the surprises around ECBGC meetings is not significant.

The share of IMC events with abnormal returns is relatively lower than for ECBGC meetings and varies between assets. This suggests that our approach of considering abnormal returns filters out a large number of IMC events that might not have been relevant in terms of the news they provided to the financial market. However, in absolute numbers, we are left with a high number of IMC events. For example, more than 400 IMC events led to abnormal returns on the Eurostoxx50 compared to 117 ECBGC events. Overall, when applied to all communication events in the EA-CED,

we find that roughly 60% of them lead to abnormal returns on at least one asset.[12]

Table 2 measures the cumulative impact of our events that lead to abnormal return, in bps for the OIS and in percentage points for the Eurostoxx50. For OIS short-term maturities, the cumulative absolute impact of ECBGC meetings associated with abnormal returns is about twice that of the cumulative absolute impact of IMC events.[13] Starting at the one-year maturity, the effects of ECBGC and IMC events are comparable (549 vs. 658 bps). At longer maturities, IMC effects grow larger-up to twice those of ECBGC meetings. For the Eurostoxx50, IMC events have three times the impact (338 vs. 113 bps), and for sovereign yields, the impact of IMC also increases with maturity (see Table F.8 to Table F.11 in the appendix).[14] When looking at the impact per event (Panel B), ECBGC meetings exert an overall larger effect than IMC events, although this difference diminishes with increasing asset maturity. We also find that the impact per event of communication by NCB governors is comparable to - and sometimes exceeds -that of the ECB Presidents and other EB members.

Inflation expectations measured by the ILS are an outlier. As shown in Table F.7, fewer than 5% of ECBGC announcements and only 5-10% of IMC events cause abnormal ILS movements. On average, IMC events have a larger per-event impact than ECBGC meetings. The limited number of ILS reactions (57 and 74, respectively) likely reflects lower market liquidity and, more fundamentally, anchored inflation expectations over most of the sample (2008-2024).

Finally, we find considerable time variation in how often communication events cause abnormal returns and in the size of their effects on interest rates. Figure C.3 in the appendix shows this evolution for the OIS1Y and OIS10Y. Peak effects mainly occur during hiking cycles and policy turning points (2008, 2011, 2022-2023).

[12]Most events affect significantly only a few assets or maturities, so their number varies across assets.
[13]Table F.1 in the appendix shows the per-event impact for all events, unfiltered for abnormal returns.
[14]These results could partly be driven by the effective lower bound period.

Table 2: Importance of events that lead to abnormal returns - OIS and stocks

	OIS									Eurostoxx50
	1999-2024					2002-2024	2011-2024			1999-2024
Events	1M	3M	6M	1Y	2Y	3Y	5Y	7Y	10Y	
	Panel A: cumulative impact									
ECBGC	433	438	465	549	580	453	279	246	233	113
All IMC	169	210	325	658	931	1019	679	745	803	338
ECB President	19	35	53	109	165	146	83	101	95	55
ECB EB	73	93	123	238	327	399	265	284	349	165
NCBs	62	67	105	228	316	366	232	252	247	98
EP hearing	7	6	30	29	44	33	12	12	9	8
Accounts	1	1	5	6	11	13	22	26	26	5
Interviews	6	7	9	49	69	61	65	71	76	7
	Panel B: impact per event									
ECBGC	4.29	3.59	3.45	3.81	4.14	4.12	4.11	3.96	3.59	0.97
ECB President	1.13	1.16	1.47	2.06	2.53	2.92	2.13	2.40	2.38	0.70
ECB EB	1.20	1.03	1.25	1.73	1.97	2.35	2.10	2.18	2.35	0.63
NCBs	1.15	1.01	1.20	1.81	2.33	2.69	2.32	2.43	2.35	0.65
EP hearing	2.42	1.61	2.75	2.62	2.42	2.38	2.92	2.90	3.12	0.70
Accounts	0.40	1.09	1.00	1.16	2.72	2.13	2.23	2.17	1.88	0.46
Interviews	1.25	0.72	1.03	1.95	2.39	3.39	3.44	3.10	3.04	0.53

Note: Panel A shows the cumulative impact of absolute asset price changes for all events with abnormal returns on the OIS rate, for maturities of one month to 10 years, and in the Eurostoxx50 returns. Panel B shows the average absolute impact of the events. ECBGC refers to ECB GC monetary policy meeting events. Rows from ECB President to EP hearing, refer to IMC events from ECB Presidents, the ECB Executive Board (EB) members, the governors of the NCBs of Germany, France, Italy, and Spain, and the European Parliament (EP) hearings of the ECB President. Accounts refers to the publication of ECB Monetary Policy Accounts and Interview to the publication of interviews of our selected GC members. All numbers denote bps changes for the OIS and percentage points for Eurostoxx50.

4 Information in IMC events with abnormal returns

Next we examine the informational content of IMC events. First, we show that they convey policy signals, steering markets toward forthcoming decisions, both conventional and unconventional. In addition, we show that this information is multidimensional, such that three factors extracted from IMC events explain most of the yield curve variation.

4.1 Signal for future monetary policy action

Media coverage of ECB GC members' speeches often highlights their clear policy signals. For example, Bloomberg (2011) writes after the ECB President's speech in June 2011: "*We are taking the decision progressively to anchor inflation expectations, Trichet said at a [non-ECBGC meeting] press conference in Amsterdam today ". "As far as we're concerned, we're in strong vigilance mode," he said, repeating a phrase the ECB uses to indicate a rate increase is imminent. The euro rose more than a cent after the comment to $1.435 at 1:50 p.m. in New York.*" The ECB raised rates by 25 bps at its next meeting in July 2011.

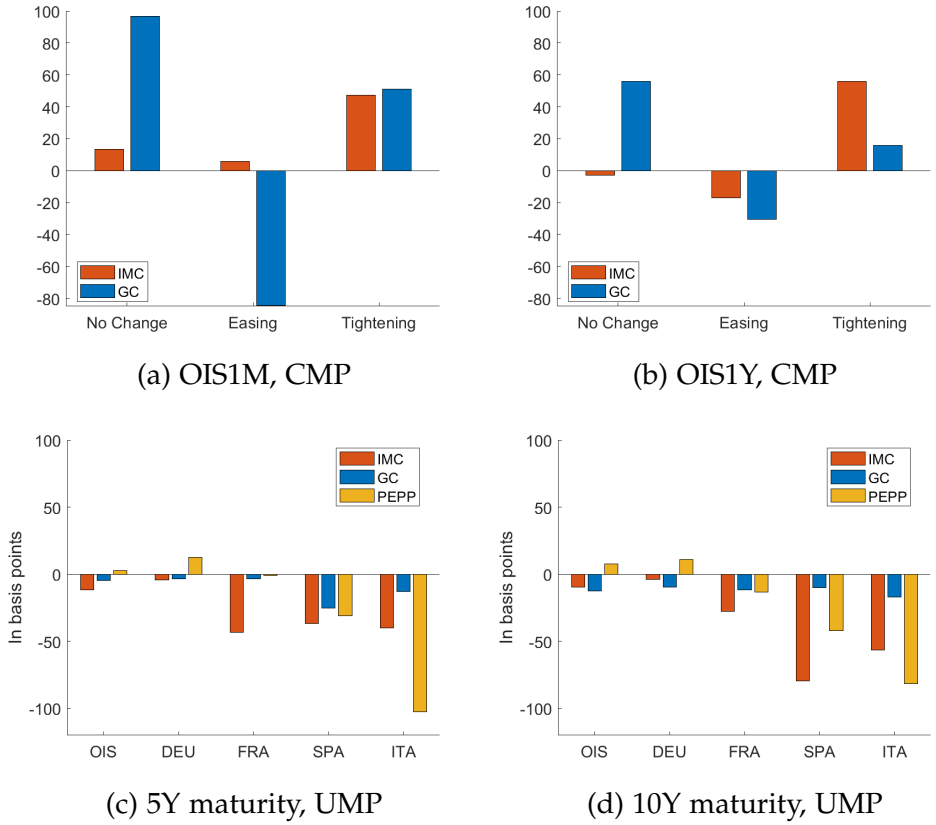
To assess whether IMC events contain policy signals, we examine market movements ahead of meetings that resulted in policy tightening, easing, or no change, based on changes to the deposit facility rate (DFR), i.e., conventional monetary policy. Panels (a) and (b) of Figure 3 show that IMC events, on average, preceding tightening decisions shift the short end of the OIS curve in the same direction as the subsequent policy move and even more than the ECBGC decision itself for maturities beyond one month. Similarly, IMC events before easing decisions generally move markets in line with future policy, except for the OIS1M, though effects are more modest.[15]

The larger effects before tightening may reflect a deliberate communication of "vigilance" to anchor inflation expectations amid rising inflation while awaiting clearer signals to act. In contrast, the smaller impact of IMC ahead of easing suggests less

[15] Figure 3 shows that ECBGC meetings with no change in policy can lead to abnormal returns. This effect is driven by four events, which took place one or two meetings ahead of a easing decision, where markets strongly repriced the expected easing.

emphasis on signaling concerns about inflation. This is consistent with the perceived ECB's asymmetric approach to its inflation goal, at least until the adoption of a symmetric 2% inflation target in July 2021.

Figure 3: Cumulative abnormal returns during and before ECBGC meetings



(a) OIS1M, CMP

(b) OIS1Y, CMP

(c) 5Y maturity, UMP

(d) 10Y maturity, UMP

Note: Panel (a) and (b) show the sum of abnormal returns of IMC and ECBGC events before and on decision days with conventional monetary policy (CMP), respectively, where the CMP decision led to a reduction in the DFR (easing), an increase in the DFR (tightening), or no change in the DFR (no change). Panel (c) and (d), show the sum of abnormal returns of IMC and ECBGC events before and on decision days on which new accommodative unconventional monetary policy (UMP) measures were announced. The units of the y-axis are basis points.

We also consider ECBGC meetings with announcements on asset purchase programs and long-term refinancing operations aimed at easing the monetary stance, supporting liquidity, or enhancing policy transmission, i.e., unconventional monetary policy.[16] Panels (c) and (d) of Figure 3 show that IMC events ahead of ECBGC with

[16]We include ECBGC announcements on the Securities Markets Programme (SMP), Asset Purchase Programme (APP), Pandemic Emergency Purchase Programme (PEPP), Outright Monetary Transactions (OMTs), LTRO, and two SMP announcements and the first PEPP announcement that took place in unscheduled ECBGC meetings. In total, there are 19 meetings, some of which include announcements of multiple unconventional measures. We do not consider announcements of tapering and termination of these programs. Odendahl et al. (2024) provide a description of these tools and their impact on the

unconventional easing announcements lead to significant drops in long-term sovereign yields, especially for Italy and Spain. On average, this effect is larger than the effects of the subsequent ECBGC announcements. German yields respond less, possibly due to scarcity effects from asset purchases or differing impacts across unconventional tools.[17] For comparison, panels (c) and (d) show separately the pronounced impact of the three PEPP announcements on Italian and Spanish yields.

4.2 Factor decomposition

In the following, we project yield curve movements around IMC (ECBGC) events onto a lower-dimensional space of structural shocks to assess their informational content. This approach is commonly used for surprises around monetary policy announcements. For example, Gürkaynak et al. (2005a) show that two factors explain yield curve movements around FOMC announcements, capturing both current policy news and forward guidance. Later work (e.g., Altavilla et al. (2019); Swanson (2021)) finds that the dimensionality of policy surprises increases as tools expand. Swanson and Jayawickrema (2024) further show that surprise factors from Fed Chair speeches are statistically indistinguishable from those around FOMC meetings, suggesting markets interpret inter-meeting communication along the same dimensions as formal announcements. Building on this literature, we extract three principal components from monetary policy surprises in the euro area around IMC and ECBGC meeting events, respectively. Then we examine their effects on financial markets using high-frequency event-study regressions.

We extract the principal components from a subset of IMC (ECBGC) events, which satisfy one of the following criteria: (i) events associated with abnormal returns on the one-month OIS (Target shocks), (ii) events that caused abnormal returns in at least two OIS rates with maturities between three months and two years (policy path or forward guidance shocks), and (iii) events that cause abnormal returns in the 10-year

yield curve.

[17] Odendahl et al. (2024) show that APP lowered long-term OIS and sovereign yields, while the SMP and PEPP had more divergent effects across yields of core and peripheral countries via risk premia.

OIS, provided that sovereign yields do not show abnormal returns of the opposite sign (quantitative easing shocks).[18] The selection criteria follow the literature on decomposing monetary policy surprises into a "Target" factor, which primarily loads on short-term OIS yields; a forward guidance (FG) factor, which mainly loads on the one- and two-year OIS rates; and a quantitative easing (QE) factor, which loads on the 10-year OIS and German sovereign yields. In the following, we refer to IMC-Target, IMC-FG, and IMC-QE factors when the factors are extracted from IMC events, and similarly for the case of ECBGC meetings.

Given the set of events, we follow Swanson (2021) in the decomposition of the surprises into three different factors:

$$X^{(j)} = F^{(j)}\Lambda^{(j)} + e^{(j)}, \tag{2}$$

where $X^{(j)}$ is a $T_j \times 7$ matrix that contains the standardized surprises of the OIS with maturities of one month to two years, five years, and 10 years, $j \in \{\text{IMC}, \text{ECBGC}\}$, and $T_{\text{IMC}} = 586$ and $T_{\text{ECBGC}} = 185$. The rows in $X^{(j)}$ contain the selection of events described above. The matrix $F^{(j)}$ is of size $T_j \times 3$ and contains the factors obtained via principal component analysis. The principal components themselves do not have an economic interpretation because any orthogonal matrix H, known as the rotation matrix, could be used to obtain an observationally equivalent factor decomposition $F^{+(j)}\Lambda^{+(j)} = F^{(j)}HH'\Lambda^{(j)}$. Therefore, we follow Swanson (2021) and impose restrictions that allow us to obtain a unique rotation matrix H^* and uniquely identified rotated factors $F^{(j)*} = F^{(j)}H^*$ that have a structural interpretation. The rotation matrix leads to an FG and QE factor with a zero loading on the OIS1M, and the rotation matrix minimizes the variance of the QE factor before 2011.[19] Moreover, the columns of the rotation matrix are orthogonal, which guarantees that the factors are uncorrelated and can be interpreted as distinct structural shocks. Finally, the columns of the rotation

[18] Events are pre-selected to avoid estimating the principal components on noisy surprises. The Appendix D shows that the results are robust to an estimation of the principal components without the pre-selection process.

[19] Using 2008 as a cutoff as in Altavilla et al. (2019) gives very similar results.

matrix have unit length and the rotated factors have a unit variance.

Then, we regress the rotated factors on the abnormal returns of different assets:

$$y_{t,i}^{(j)} = \alpha_i^{(j,k)} + \beta_i^{(j,k)} F_t^{(j,k)*} + u_{t,i}^{(j,k)}, \tag{3}$$

where $y_{t,i}^{(j)}$ is the surprise of asset y at event t with $j \in \{\text{IMC}, \text{ECBGC}\}$, i denoting a specific asset, and $k \in \{\text{Target}, \text{FG}, \text{QE}\}$.

Table 3 shows the estimates of $\beta_i^{(j,k)}$ when regressing the three identified factors on the surprises of OIS rates of different maturities.[20] Results show that for both IMC and ECBGC events, the Target factor's impact declines with OIS maturity, while the FG factor has a hump-shaped profile, peaking at a longer maturity in the case of IMC. While IMC effects are expected to operate mainly through the forward guidance factor, consistent with a signaling channel discussed earlier, we find that the IMC-Target factor also has a significant impact. This is notable, as IMC events do not involve actual policy decisions, making this factor less directly comparable to its ECBGC counterpart. Finally, a formal test rejects the null hypothesis of equal impact along the OIS yield curve, suggesting that IMC and ECBGC shocks affect the yield curve differently.[21,22]

In addition, Table 4 shows that the IMC-Target and IMC-FG factors have significant effects on sovereign yields and on the Eurostoxx50. For IMC events, the positive sign of the Target and FG factor on Eurostoxx50 suggests that, on average, a central bank information effect dominates the "pure" monetary policy effect (Jarociński and Karadi, 2020). In Table D.1 in the appendix we show that the IMC QE factor is significant for sovereign spreads, whereby a tightening QE surprise increases the term spread but decreases the risk spreads. The ECBGC factors are significant only for the term spread.

[20] Coefficients in Table 3 are identical to the rotated factor loadings $\Lambda^{(j)*} = H^{*'}\Lambda^{(j)}$ for maturities of one month to two years, five years, and ten years. Since the variance of the rotated factors is one, the coefficients across IMC and ECBGC events are comparable in terms of unit standard deviation effects.

[21] Results are not reported here and available upon request.

[22] Swanson and Jayawickrema (2024) find that factors estimated on Fed Chair speeches and FOMC announcements are statistically indistinguishable in terms of their impact on the yield curve.

Table 3: Effect of IMC and ECBGC factors on OIS rates

		OIS								
		1M	3M	6M	1Y	2Y	3Y	5Y	7Y	10Y
		Panel A: Target factor								
IMC	β_i^j	**0.93**	**0.70**	**0.69**	**0.72**	**0.65**	**0.58**	**0.57**	**0.50**	**0.54**
	pval	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)
	R2	0.96	0.63	0.38	0.20	0.09	0.06	0.05	0.04	0.05
ECBGC	β_i^j	**4.99**	**4.11**	**3.36**	**2.66**	**1.83**	**1.44**	**1.03**	0.50	0.17
	pval	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(0.02)	(0.03)	(0.11)	(0.52)
	R2	0.97	0.87	0.64	0.33	0.14	0.09	0.05	0.02	0.00
		Panel B: FG factor								
IMC	β_i^j	0.00	**0.31**	**0.72**	**1.39**	**2.02**	**2.14**	**2.21**	**2.03**	**1.87**
	pval	(1.00)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)
	R2	0.00	0.13	0.43	0.73	0.85	0.84	0.79	0.69	0.60
ECBGC	β_i^j	0.00	**1.04**	**2.28**	**3.74**	**4.48**	**4.41**	**4.12**	**3.38**	**2.54**
	pval	(1.00)	(0.04)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)
	R2	0.00	0.06	0.30	0.64	0.83	0.84	0.83	0.78	0.61
		Panel C: QE factor								
IMC	β_i^j	-0.00	**-0.32**	**-0.42**	**-0.30**	0.01	**0.28**	**0.88**	**1.09**	**1.34**
	pval	(1.00)	(< 0.01)	(< 0.01)	(< 0.01)	(0.94)	(0.03)	(< 0.01)	(< 0.01)	(< 0.01)
	R2	0.00	0.13	0.14	0.03	0.00	0.01	0.12	0.20	0.31
ECBGC	β_i^j	-0.00	**-0.85**	**-0.84**	-0.65	0.09	0.57	**1.42**	**1.70**	**1.96**
	pval	(1.00)	(0.07)	(0.09)	(0.22)	(0.86)	(0.26)	(< 0.01)	(< 0.01)	(< 0.01)
	R2	0.00	0.04	0.04	0.02	0.00	0.01	0.10	0.20	0.37

Note: The table shows estimates of $\beta_i^{(j)}$ of eq. (3). Boldface numbers indicate significance at the 10% level. Numbers in parenthesis denote bootstrap p-values of a t-test for the null hypothesis that $H_0 : \beta_i^{(j)} = 0$. The bootstrap p-values are obtained by bootstrapping both the first stage, the factor extraction, and the second stage via a wild bootstrap (see details in the appendix). The row $R2$ shows the R-squared of the regressions.

Table 4: Effect of IMC and ECBGC factors on sovereign yields and the Eurostoxx50

		DEU2Y	ITA2Y	SPA2Y	DEU10Y	ITA10Y	SPA10Y	Eurostoxx50
				Panel A: Target factor				
IMC	β_i^j	**0.54**	**0.35**	**0.31**	**0.51**	**0.33**	**0.45**	**2.43**
	pval	(< 0.01)	(0.03)	(0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)
	R2	0.05	0.01	0.01	0.04	0.01	0.02	0.03
ECBGC	β_i^j	**1.85**	**1.39**	**1.41**	0.08	0.54	0.11	**-0.13**
	pval	(< 0.01)	(0.02)	(< 0.01)	(0.79)	(0.42)	(0.78)	(0.06)
	R2	0.12	0.03	0.06	0.00	0.01	0.00	0.03
				Panel B: FG factor				
IMC	β_i^j	**2.12**	**2.07**	**1.83**	**1.98**	**2.00**	**1.87**	**2.25**
	pval	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(0.02)
	R2	0.80	0.38	0.28	0.58	0.39	0.31	0.02
ECBGC	β_i^j	**4.90**	**4.89**	**4.13**	**2.85**	**3.72**	**3.18**	**-0.18**
	pval	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(0.05)
	R2	0.82	0.44	0.54	0.59	0.26	0.31	0.05
				Panel C: QE factor				
IMC	β_i^j	**0.33**	-0.09	0.11	**1.41**	**0.99**	**0.84**	0.44
	pval	(< 0.01)	(0.67)	(0.65)	(< 0.01)	(< 0.01)	(< 0.01)	(0.65)
	R2	0.02	0.00	0.00	0.30	0.10	0.06	0.00
ECBGC	β_i^j	0.13	0.52	0.14	**2.17**	**2.07**	**1.87**	-0.07
	pval	(0.83)	(0.49)	(0.81)	(< 0.01)	(< 0.01)	(< 0.01)	(0.43)
	R2	0.00	0.00	0.00	0.34	0.08	0.11	0.01

Note: The table shows estimates of $\beta_i^{(j)}$ of eq. (3). Boldface numbers indicate significance at the 10% level. Numbers in parenthesis denote bootstrap p-values of a t-test for the null hypothesis that $H_0 : \beta = 0$. The bootstrap p-values are obtained by bootstrapping both the first stage, the factor extraction, and the second stage via a wild bootstrap (see details in the appendix). The row $R2$ shows the R-squared of the regressions.

5 Macroeconomic effects of euro area monetary policy

In this section, we demonstrate how IMC surprises can be used to identify monetary policy shocks within a Bayesian Vector Autoregression (BVAR) framework. In particular, we use IMC surprises to inform narrative sign restrictions (NSR) (Antolín-Díaz and Rubio-Ramírez, 2018) in a model that imposes minimal (traditional) sign restrictions.

Following the notation of Antolín-Díaz and Rubio-Ramírez (2018), the VAR in its structural form can be represented as

$$y_t' A_0 = x_t' A_+ + \epsilon_t' \tag{4}$$

where $A_+' = [A_1' \ ... \ A_p' \ c']$ and $x_t' = [y_{t-1}', \ ... y_{t-p}', \ 1]$. The matrices A_+ and A_0 contain the structural parameters of the model and ϵ_t is the series of structural shocks. For further details, see Antolín-Díaz and Rubio-Ramírez (2018).

The dependent variable y_t is of size 6×1 and contains the log level of monthly interpolated euro area real GDP[23], the log level of the euro area HICP index, the euro area unemployment rate, the spread of the Bank of America BBB non-financial institution rate and the one-year German sovereign yield, the log level of Eurostoxx50, and the OIS2Y interest rate. We include the spread as a measure of financial conditions following Jarociński and Karadi (2020). Since short-term rates were arguably at the effective lower bound (ELB) and bounded by forward guidance for several years in our sample, the OIS2Y can better represent the monetary policy stance when both conventional and unconventional tools are active. The sample spans from January 2002 to January 2024 (265 monthly observations).[24] In the baseline specification, we set the number of lags, p, equal to six and we use a flat uniform-normal-inverse Wishart prior, where we set the prior mean and variance to their OLS counterparts.

The baseline identification of the monetary policy shock is based on sign restrictions:

[23]The monthly values are obtained by interpolating quarterly real GDP using a Chow-Lin (Chow and loh Lin, 1971) interpolation. Results are robust when using monthly industrial production instead of the interpolated real GDP and are reported in Section E.2.

[24]Note that we drop the observations from March 2020 to October 2020 from the sample since the observations during the onset of the COVID pandemic can severely alter parameter estimates in a BVAR (Lenza and Primiceri, 2022).

i) the response of OIS2Y rate is positive and remains so for at least seven additional months[25], and ii) the impulse response function (IRF) of the Eurostoxx50 is negative on impact and remains negative for at least two additional months. The sign restriction for the effect of a monetary policy shock resembles the assumptions in Jarociński and Karadi (2020), whereby a negative co-movement between the interest rate and stock prices reflects news about monetary policy. Importantly, the IRFs of all other variables remain unrestricted such that the overall imposed sign restrictions are minimal.

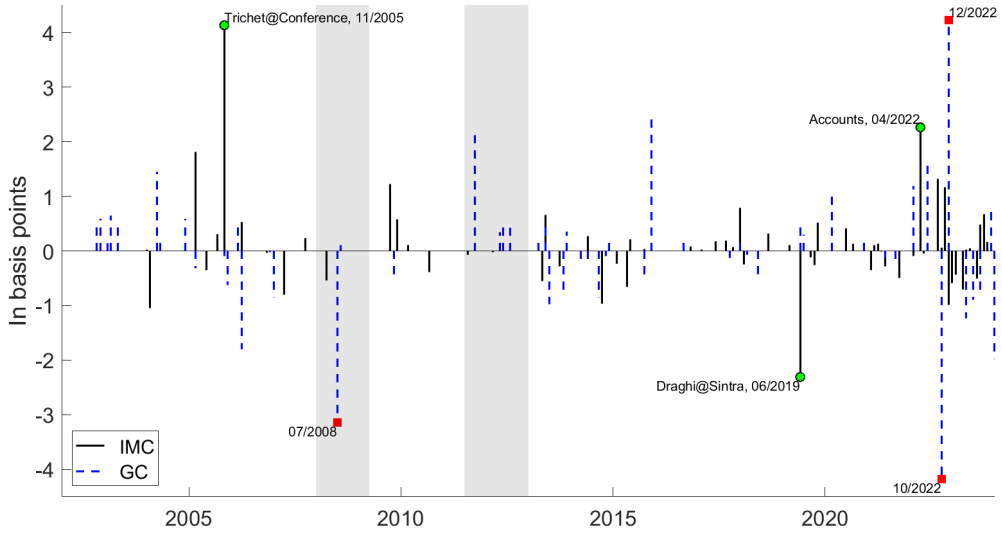
The dashed line in Figure 5 shows the (point-wise) posterior median IRF to a monetary policy shock identified *only* via the sign restrictions on the negative co-movement of the interest rate (OIS2Y) and the Eurostoxx50; the grey-shaded areas show respective 68% credible sets. The monetary policy shock is normalized to a size of 25 bps on impact on the OIS2Y. Following the tightening shock, real GDP falls and unemployment rises, as theory predicts for a monetary policy shock. However, the credible sets are very wide. More notably, HICP inflation increases by about 0.5% at its peak in response to tightening, leading to a "price puzzle" that suggests the sign restrictions used are insufficient to properly identify the effects of a monetary policy shock.

Instead of imposing additional sign restrictions, we employ narrative sign restrictions based on the events in the EA-CED. First, we select Target and FG factor shocks which are of opposite sign to a *abnormal* Eurostoxx50 return, i.e., shocks which constitute *pure* monetary policy news in the sense of Jarociński and Karadi (2020). Then, we aggregate the respective impact of these Target and FG shocks on the OIS2Y rate from both IMC and ECBGC events to a monthly frequency. The aggregated monthly effects are shown in Figure 4, where solid vertical lines represent the impact of IMC-based shocks, and dashed vertical lines represent the impact of ECBGC-based shocks. We observe that some months stand out in terms of their magnitude, both for ECBGC meetings and IMC. Several of these months are concentrated in the later part of the sample, coinciding with the recent inflation surge and the subsequent monetary policy

[25]The restriction imposes some persistence in the response of the interest rate but results are robust to shortening this restriction to three periods.

tightening cycle. For both the ECBGC and the IMC, we highlighted the three months in which the Target and FG shocks had the largest impact on the OIS2Y by marking them with filled squares (ECBGC) and filled circles (IMC). We use these months for the construction of narrative restrictions. Starting with IMC, the months in which we impose narrative sign restrictions are November 2005, June 2019, and April 2022.

Figure 4: Target and FG factor shocks' impact on the OIS2Y at a monthly frequency



Note: The figure shows the impact of the Target and FG factor on the OIS2Y based on IMC and ECBGC, on a monthly frequency. Only Target and FG factors that have a negative co-movement with the Eurostoxx50 are taken into consideration. Solid lines show the impact of IMC-based factors and dashed lines show the impact of ECBGC-based factors. Filled circles (squares) show the three largest impacts of IMC-based (GC-based) factors. For ECBGC meetings, the text denotes the month of the surprise. For IMC, the text denotes the main event driving the factors in the respective month.

Narrative Sign Restriction 1 (IMC-NSR1). *The monetary policy shock in November 2005 has a positive sign. The Governing Council met on November 3, 2005, and decided to leave policy rates unchanged. This decision did not cause an abnormal return in the OIS2Y and the impact of the ECBGC-Target and ECBGC-FG shock on the OIS2Y is zero in this month. In contrast, our IMC database suggests that an important IMC event in this month is the speech given by the ECB president, Jean-Claude Trichet, on November 18, 2005. This event is associated with a positive IMC-Target and IMC-FG shock that moves the OIS2Y by more than four bps. According to the New York Times (NYT, 2005): "ECB made it clear it will raise rates. [...] "We will remove some of the accommodation which is in the present monetary policy stance," Trichet said in what amounted to a remarkably blunt warning from a*

normally circumspect central banker. [...] The remarks reverberated through European markets, briefly reversing the dollar's rally against the euro. [...]" It was very clear, therefore, it is very consequential," said Thomas Mayer, the chief European economist at Deutsche Bank. "Apparently, there is now an agreement on the board that they should move soon."". Moreover, FT (2005) writes: "The euro fell from a two-week high against the dollar after European Central Bank president Jean Claude-Trichet reined in expectations that the bank was poised to embark on a series of interest rate rises. On Friday he signalled the eurozone central bank would raise interest rates in December and the market pencilled in further tightening early in 2006." Indeed, consistent with the policy signal conveyed in the speech, the ECB raised its policy rates in the meeting on December 1, 2005. This speech signaled the first tightening of interest rates in five years, after more than two years of unchanged policy. The media coverage suggests that this speech was important in shaping market expectations about the path of policy for the year ahead.

Narrative Sign Restriction 2 (IMC-NSR2). *The monetary policy shock in November 2005 is the most important driver of the unexpected component of the OIS2Y in November 2005. This restriction implies that in absolute value the impact of the monetary policy shock on the reduced form residual of the OIS2Y in this month is larger than the impact of any other structural shock. This assumption is motivated by the magnitude of the impact of the IMC-based Target and FG shock in this month.*

Narrative Sign Restriction 3 (IMC-NSR3). *The monetary policy shock has a negative sign in June 2019. The ECBGC-Target and ECBGC-FG impact on the OIS2Y is positive and 0.4 bps in this month. In contrast, the IMC-Target and IMC-FG impact is -2.4 bps this month. In its meeting on 6 June 2019, the Governing Council left policy rates unchanged, while it extended its forward guidance on interest rates to "remain at their present levels at least through the first half of 2020" instead of "through the end of 2019". Later in the month, Mario Draghi gave a speech at the ECB Forum in Sintra, on June 18. In this speech, Draghi stated that "In the absence of improvement, such that the sustained return of inflation to our aim is threatened, additional stimulus will be required". CNBC (2019) writes: "Speaking at the ECB Forum in Sintra, Portugal, Draghi gave a defiantly dovish tone, saying that if*

the economic situation deteriorates in the coming months the bank would announce further stimulus. The euro dropped 0.2% against the dollar in a matter of minutes as Draghi delivered the remarks. The German 10-year bund yield hit -0.30% for the first time ever and the U.S. 10-year Treasury yield hit its lowest since September 2017 at 2.0475%". Similarly, Bloomberg (2019) writes, "Mario Draghi nudged the European Central Bank closer to pumping more monetary stimulus into the economy, highlighting that lingering risks are strengthening the case for action." Since the speech conveyed a strong easing signal, we impose the restriction that the monetary policy shock in June 2019 was an accommodative shock. In the meeting of September 2019, the ECB decided to lower further the deposit facility rate to -0.50% and announced the restart of net purchases through the asset purchase programme (APP).

Narrative Sign Restriction 4 (IMC-NSR4). *The monetary policy shock has a positive sign in April 2022. Markets were surprised on the upside on April 7, 2022, by the release of the ECB Monetary Policy Accounts of the March 2022 meeting. The IMC-Target and IMC-FG shock had an impact of 2.3 bps on the OIS2Y. Referring to the release of the Accounts, Reuters (2022) writes, "European Central Bank policymakers appeared keen to unwind stimulus at their March 10 meeting, with some pushing for even more action, as conditions for raising rates had either been met or were about to be met, the Accounts of the gathering showed." Similarly, ING (2022) writes, "Probably the most important message from the minutes is the paragraph that many members believed that the current high level of inflation and its persistence called for immediate further steps towards monetary policy normalization. That's a clear signal that the announced policy normalization at the March meeting might not be sufficient." However, on April 14, 2022, the Governing Council meeting announcement surprised markets to the downside, i.e., interest rates dropped, and the ECBGC-Target and ECBGC-FG shock caused the OIS2Y to decrease by 1.5 bps. Although the Eurostoxx50 increased, the reaction is not an abnormal return. Consequently, we do not consider this event as a pure monetary policy shock. Note that even if the ECBGC announcement was counted as a pure policy shock the overall impact of IMC- and ECBGC-Target and FG shocks in this month would be negative. Further, there are three additional IMC-Target and IMC-FG shocks in this month with an additional cumulative positive impact of 2 bps on the OIS2Y all of which are associated with a decline but*

not abnormal decline in the stock market and, therefore, similar to the ECBGC not counted when determining the April 2022 narrative sign restriction.

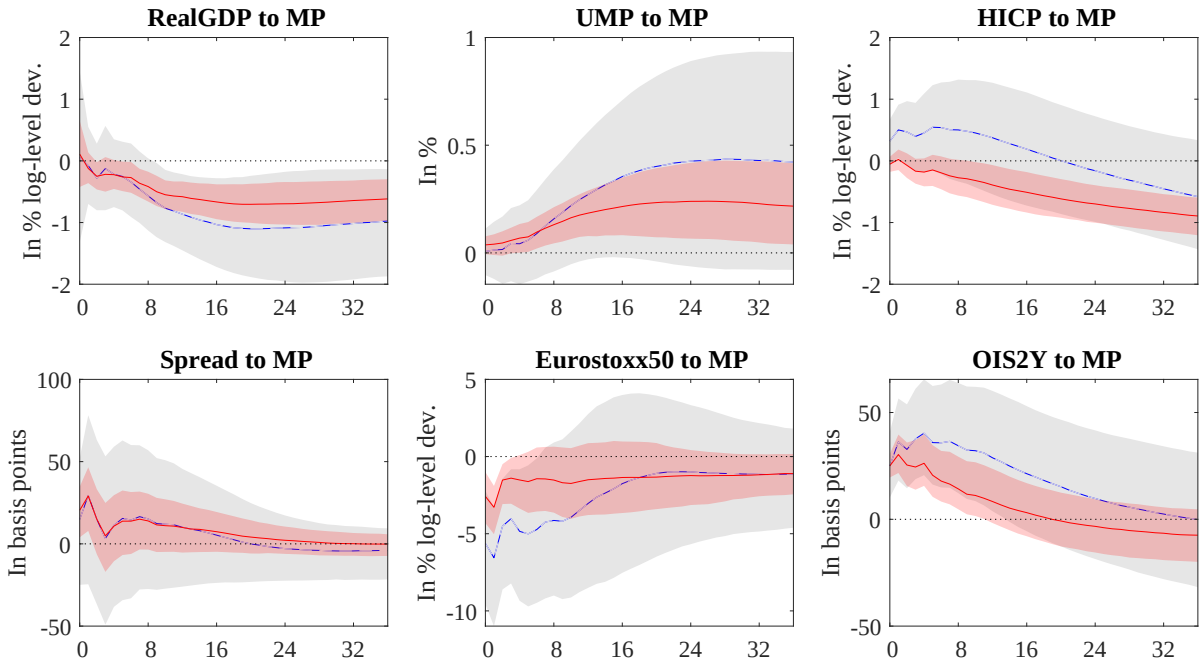
Results for IMC-based narrative restriction. The solid lines in Figure 5 show the posterior median IRF under sign *and* our four narrative sign restrictions (SR&NSR); the red shaded areas show the respective 68% credible set. These results are based on 100,000 draws that satisfy the sign restrictions of which around 4.0% satisfy both the sign *and* narrative sign restrictions, leaving us with around 4,000 unique posterior draws for SR&NSR.

The posterior median response under SR&NSR is notably different from the SR-only posterior median response. The responses of real GDP, the unemployment rate, the Eurostoxx50, and the OIS2Y rate are all significant at the 68% confidence level. Most importantly, under SR&NSR, the response of HICP to the shock changes sign and becomes negative, indicating that imposing IMC-NSR1 to IMC-NSR4 resolves the price puzzle. Additionally, the spread increases significantly on impact, aligning with findings in the existing literature (Jarociński and Karadi, 2020). Further, the credibility intervals are considerably tighter for all variables, indicating that the NSR helps to narrow down the set of permissible draws.

Governing Council meeting narrative restriction. For comparison, we apply narrative sign restrictions based solely on the days of Governing Council meetings. As shown in Figure 4, three meetings stand out in terms of the magnitude of their impact on the OIS2Y: October 2022, December 2022, and July 2008. Accordingly, we impose that the monetary policy shock in December 2022 was positive and negative in October 2022 and July 2008. In addition, we impose that the monetary policy shock was the dominant shock for the OIS2Y in October 2022; this restriction is similar to the IMC-NSR2. See Section E.2 for a description of the ECBGC restrictions.

We compare the impulse responses from identifying the monetary policy shock using IMC and ECBGC narrative restrictions, respectively, in Figure 6. The IRFs of the SR&ECBGC-NSR are presented in dashed line and grey shaded area, and those from the SR&IMC-NSR in solid line and red shaded area. For most of variables, the point

Figure 5: Monetary policy shock: sign vs sign + IMC narrative restrictions 1 to 4



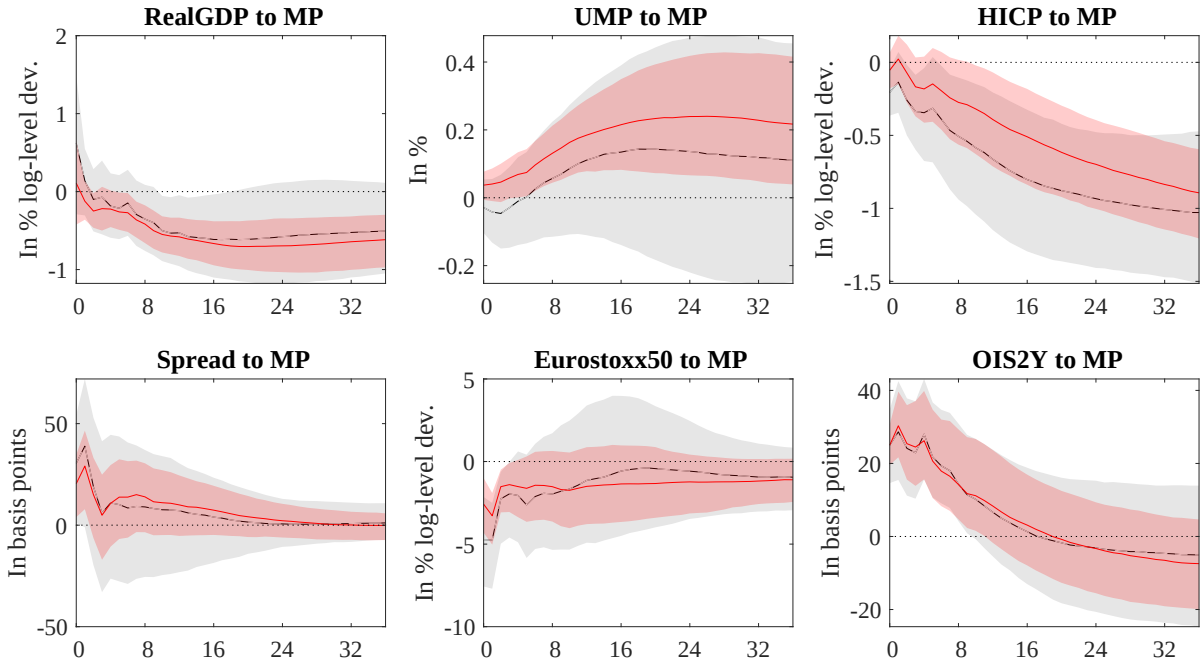
Note: The dashed line shows the posterior median of the IRFs to a 25 bps monetary policy shock with the sign restrictions on the OIS2Y and the Eurostoxx50 index. The solid line shows the posterior median of the IRFs when using the sign + narrative sign restrictions, based on IMC events (11/2005, 06/2019, 04/2022) as discussed in the main text. Grey and red shaded areas show the 68% credible sets.

estimates are very similar for both identification strategies, suggesting that, despite the differences in the impact of the factors on the yield curve found in Section 4, the identification strategies estimate very similar impulse response functions. Note that the credible sets are considerably tighter for the SR&IMC-NSR suggesting that the imposed IMC narrative restrictions convey more information to the model than the ECBGC based restrictions. In particular, under the SR&ECBGC-NSR restrictions, the responses of the unemployment rate and the spread are insignificant.

Figure E.2 in the appendix reports results when imposing a combination of IMC and ECBGC narrative restrictions. Specifically, we impose IMC-NSR1 to IMC-NSR3 and ECBGC-NSR1 and ECBGC-NSR3, described in the appendix, jointly. We find that the IRFs from this joint identification closely resemble the IRFs of the baseline model, identified using IMC-NSR1 to IMC-NSR4 restrictions.

Badinger and Schiman (2023) employ surprises from Governing Council meeting days to identify the effects of monetary policy within a BVAR framework, using

Figure 6: Monetary policy shock: IMC vs ECBGC based narrative restrictions



Note: The dashed line shows the posterior median of the IRFs to a 25 bp monetary policy shock with sign restrictions imposed on the OIS2Y and the Eurostoxx50 index and the ECBGC-based narrative sign restrictions imposed in month 10/2022, 12/2022, and 2008/07. The solid line shows the posterior median of the IRFs to a 25 bp monetary policy shock with the sign restrictions on the OIS2Y and the Eurostoxx50 index and the IMC-based narrative sign restrictions IMC-NSR1 to IMC-NSR4, as discussed in the main text. Grey and red shaded areas show the 68% credible sets.

narrative sign restrictions alone. They impose four restrictions based on surprises in October and November of 2008 and 2011.[26] We show that IMC events are similarly informative as narrative restrictions to identify the effects of monetary policy shocks on the macroeconomy in the euro area.

Finally, we conduct a variety of robustness checks, which are reported in Section E.2. In particular, the results are robust to using the shadow rate (Krippner, 2013) instead of the OIS2Y rate, the monthly industrial production instead of the interpolated monthly real GDP, to a variety of different prior and lag-length specifications as well as shorter sign restrictions on the OIS2Y.

[26]These were years of exceptional financial market volatility, both in interest rates and equity indices in the euro area. Ricco et al. (2024) show that surprises during periods of high market volatility tend to carry a noisier signal, requiring adjustment for information effects. After accounting for the information effect, Ricco et al. (2024) find that Target factor surprises are close to zero for October and November 2008. Consistent with these findings, our EA-CED database indicates that, among the four events, only July 2008 meets the condition of an ECBGC meeting that significantly impacts both OIS rates and the Eurostoxx50.

6 Concluding remarks

This paper presents the *Euro Area Communication Event-Study Database* (EA-CED), consisting of ECBGC monetary policy meeting and inter-meeting communication events and their impact on euro area financial variables, measured using high-frequency data, for the 1999 to 2024 period.

Overall, we document that markets react significantly to inter-meeting communication of Governing Council members, in the form of speeches and interviews. The overall impact of IMC on financial market movements is comparable in size to the impact of Governing Council policy announcements. Similarly to ECB policy announcements, information in IMC is multidimensional, signaling news about both the path of the economy and of policy. Importantly, we find that surprises based on IMC events can be used to identify monetary policy shocks in the euro area that have a significant impact on real GDP and consumer prices.

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Appendix A Data and EA-CED

A.1 Data

Table A.1: Eurosystem Communication Events

Type of event	Sample	Source	Observations
Monetary policy meeting communication			
ECBGC monetary policy meetings	1999-2024	BBG	**304**
Inter-meeting communication (IMC)			
ECB			**3369**
Presidents	1999-2024	BBG	737
Presidents' EU Parliament Hearings	1999-2024	BBG	122
Executive Board (excl. president)	1999-2024	BBG	2510
National Central Banks (NCBs)			**1858**
Bundesbank	1999-2024	BBG	748
Banque de France	1999-2024	BBG	430
Banca d'Italia	1999-2024	BBG	290
Banco de España	1999-2024	BBG	390
Interviews (ECB+NCBs)	1999-2024	Refinitiv Eikon	**241**
ECB Monetary Policy Accounts	2015-2024	BBG	**75**

Note: The table shows the different types of communication events in our Eurosystem Events database that are based on the BBG calendar. For each type, we report the sample period, the source, and the number of observations. ECBGC denotes ECB Governing Council monetary policy meeting events, BBG denotes Bloomberg database. We include as ECBGC meetings three announcements that took place in unscheduled ECBGC meetings: the SMP (10 May 2010 and 8 August 2011) and PEPP on 18 March 2020.

Table A.2: Sample of OIS rates and sovereign yields data - starting month/year

	1M	3M	6M	1Y	2Y	3Y	5Y	7Y	10Y
DE	NaN	Oct-2005	Oct-2005	Apr-2000	Jan-1999	Jan-1999	Jan-1999	Jan-1999	Jan-1999
FR	NaN	Jan-1999	Jan-1999	Jan-1999	Jan-1999	Jan-1999	Jan-1999	Jan-1999	Jan-1999
IT	NaN	Jul-2009	Jul-2009	Jul-2009	Jan-1999	Jan-1999	Jan-1999	Jan-1999	Jan-1999
ES	NaN	Oct-2010	Oct-2010	Oct-2010	Jan-1999	Jan-1999	Jan-1999	Jan-1999	Jan-1999
OIS	Jan-1999	Jan-1999	Jan-1999	Jan-1999	Nov-1999	Sep-2002	Jun-2011	Jun-2011	Jun-2011

Notes: The table shows the starting month and year from which minute-by-minute quotes of the respective financial instruments are available in our database. DE, FR, IT, and ES denote the sovereign yields, at maturities indicated by the column names, for Germany, France, Italy, and Spain. The OIS are Eonia Overnight Indexed Swaps until the end of 2019 and €STR since 2020.

A.2 EA-CED

The final set of asset price changes around ECBGC and IMC events included in our EA-CED consists of 304 ECBGC policy events and about 5,100 IMC events out of the $\approx$ 5,550 events in Table A.1, after excluding IMC events on weekends and library openings. Out of the 5,100 events, 121 have two or more speakers listed in the event title that are part of the ECB Executive Board or a Governor of one of the NCBs that we consider. A few events also have listed one of the GC members that we consider and additionally a speaker that is not part of the ECBGC. We do not separately control for these cases and attribute the event to the ECBGC member. Whenever a table shows results disaggregated by the type of speaker, the multi-speaker events are double counted; for instance, if the ECB President and an NCB Governor speak at the same time, the event counts towards both ECB President as well as NCBs.

Importantly, the EA-CED includes the subset of events that we classify as leading to abnormal returns.

The timestamp in the EA-CED for all events is the Central European Time (CET), i.e. Berlin/Madrid/Paris time, which is UTC+2 during the summer daylight-saving period and UTC+1 otherwise.

The ECB provides a speech database (ECBDB) for ECB Executive Board members, containing the date of the speech, the name of the speaker, the title and the text of the speech.[27] A disadvantage of this database is the lack of the time of the day when

[27] Available on the ECB's website: https://www.ecb.europa.eu/press/key/html/downloads.en.html.

the speech started. For the EA-CED, we matched the events of the BBG calendar with those in the ECBDB so that the researcher has information on both the text of the speech and the time of the speaking event, a prerequisite for a high-frequency analysis.

Appendix B Surprises around ECBGC meetings

In the construction of high-frequency movements around monetary policy meetings, we follow the methodology of Altavilla et al. (2019) when applicable. Unlike their paper, our database consists of minute-by-minute quotes instead of tick-by-tick. Hence, we proceed as follows. We clean the quotes for misquotes and outliers on the days of the monetary policy events that we consider. Misquotes are defined by quotes with a negative bid-ask spread or a bid-ask spread that is 50 times larger than the median bid-ask spread on that day; we additionally identify and clean a few hand-selected misquote instances where, for example, the quotes changed by several hundred basis points (bps) from one minute to the other.

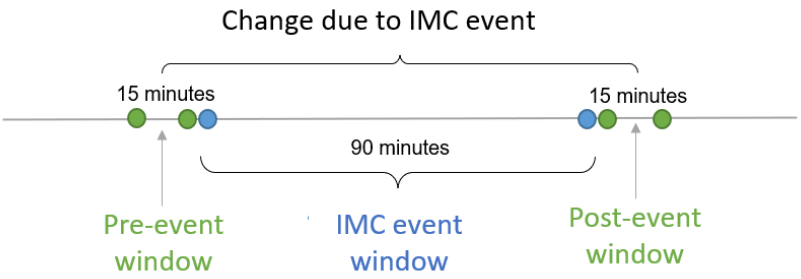
We construct surprises over the full monetary policy event window, as in Altavilla et al. (2019) as follows. After an ECB Governing Council (GC) meeting, there is a press release published at 1:45 pm, which contains the monetary policy decisions. This is followed by a press conference at 2:30 pm, which lasts for about an hour and includes time for a Q&A with financial journalists. Note that for several ECB Governing Council meetings, these times are different and we use the comprehensive list of ECBGC press release and press conference times provided in the appendix of Altavilla et al. (2019) to account for those exceptions. Notice also that the time of the press release and press conference has changed since June 2022, taking now place at 2:15 pm and 2:45 pm, respectively. In the computation of asset price returns, we modified the pre- and post-event windows accordingly. The overall monetary event surprises are computed as the difference between the median quote from 1.25pm to 1.35pm and the median quote from 3:40 to 3:50 pm, i.e. covering the entire time period from before the press release to after the end of the press conference. We define the beginning and end of the time windows of press releases or press conferences that were published or occurred at a different time following the same logic explained above.

In our database, we include three special announcements following unscheduled governing council meetings (the SMP announcement of 5 October 2010, the SMP

activation of 8 July 2011 and the PEPP announcement of 18 March 2020) and two speeches by president Draghi that took place on a Friday evening (CET), one at Jackson Hole on 22 August 2014 and one in New York on 4 December 2015. For these two events, we compute the surprises as follows. The pre-event price is computed by taking the median of the quotes from 5:45pm to 6:00 pm of the last trading day before the event. The post-event price is computed by taking the median of the quotes from 5:45 pm to 6:00 pm on the first trading day after the event. The surprise is then the difference between the post- and pre-event price. For those events we do not compute predictive intervals to assess their significance but rather we assume that they lead to abnormal returns due to the fact that they are found to be important events in the literature (see for instance Odendahl et al. (2024)).

Appendix C Estimation of abnormal returns

Figure C.1: IMC event-study timeline



Note: The start of the event is based on the BBG calendar. We set the pre- and post-event window to 15 minutes and the speaking event window (the speaking event length) to 90 minutes for regular IMC events, 180 minutes for European Parliament hearings of the ECB President, and 45 minutes for the publication of the Accounts.

C.1 Methodology for classifying events as abnormal

We start with a model of X_t, the log asset price or interest rate in basis points, as Brownian motion, without drift

$$X_t = \sigma W_t, \tag{5}$$

where W_t is a Brownian motion, $\sigma > 0$, for $t = 0, ..., T$, with $X_0 = 0$ and the time-continuous diffusion is then $dX_t = \sigma dW_t$. Note that the specification of the Brownian motion implies that the predicted mean, μ_{t_1}, is equal to zero.[28]

The specification of

$$\tilde{X}_t = X_t + U_t, \tag{6}$$

implicitly assumes that there is a quote available in every minute. However, since in our dataset prices are sampled at discrete non-equidistant time-intervals, let τ_j denote the observation at time $j = 1, ..., N_T$, $\sum_{j=1}^{N_T} \Delta_j = T$, and let $\tau_j - \tau_{j-1} = \Delta_j$ denote the sampling interval length and let $\tau_{j+h} - \tau_j = \Delta_h$ denote a generic interval of length h; the minimum interval length is one minute and the actual interval length between observations depends on the data. Then, adding market microstructure noise denoted by U_{τ_j}, the time-discrete process can be written as (Aït-Sahalia et al., 2005)

$$\tilde{X}_{\tau_j} = X_{\tau_j} + U_{\tau_j}, \tag{7}$$

where $\tilde{X}_{\tau_j}$ denotes the actual observed transaction price, and U_{τ_j} is an independent and identical distributed Normal random variable with mean zero and variance a^2.

The estimated variance of the interest rate change (return) $Y_{\tau_j} = \tilde{X}_{\tau_j} - \tilde{X}_{\tau_{j-1}}$ over time interval $\tau_j - \tau_{j-1} = \Delta_j$ is

$$\widehat{\text{var}}(\tilde{X}_{\tau_j} - \tilde{X}_{\tau_{j-1}}) = \Delta_j \widehat{\sigma}^2 + 2\widehat{a}^2. \tag{8}$$

where $\widehat{\sigma}$ and $\widehat{a}$ are estimated using data up until before the event. The variance of $(\tilde{X}_{\tau_j} - \tilde{X}_{\tau_{j-1}})$ linearly increases with prediction horizon in the variance of the process X_t, whereas the variance of the microstructure noise does not accumulate over time. We require at least 10 quotes to be recorded before the start of the event. If 10 or fewer quotes are available, we do not proceed with the testing procedure for the specific event and we drop the event from further analysis. In addition, we used at most the

[28] An alternative specification could include a drift component to account for a pre-event trend. We leave the further exploration of different specifications for future research.

last 120 quotes before the start of the event to avoid congesting the variance estimates with data from several hours ago. We always estimate the variance until the start of the event, also if there are multiple events per day, i.e., the potential increase of the volatility of prior events on the same day is taken into account.

The estimation of σ and a is done via maximum likelihood, see Aït-Sahalia et al. (2005) for estimation details. Given the estimates of σ and a, we can test the null hypothesis of no abnormal return by computing the out-of-sample predictive intervals for Y_{τ_j} as $0 \pm z_{\frac{\alpha}{2}} \sqrt{\Delta_h \widehat{\sigma}^2 + 2\widehat{a}^2}$, where Δ_h is set equal to the length of the event window and we set $\alpha = 10\%$.

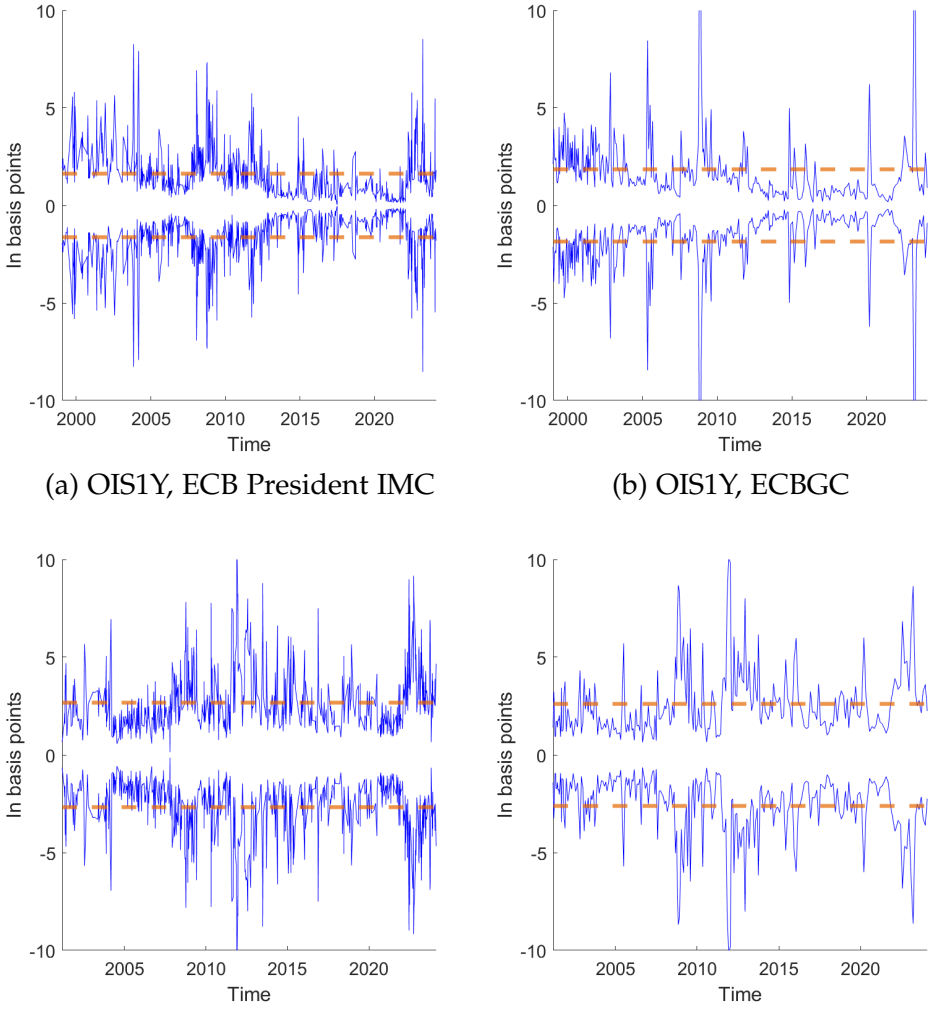
Note that the variance parameters, σ and a, and subsequently the predictive bands are computed for individual quotes whereas we compute the asset change based on the median of a few pre- and post-event quotes; see Section 3. Since the median of a few quotes has a lower variance than individual quotes, the predictive bands we compute for the asset price changes should be considered an upper bound of the predictive intervals for the asset price changes based on the difference of medians. In other words, our procedure provides conservative predictive bands.

Figure C.2 illustrates the estimates of the intraday variance for the ECBGC policy announcements and the IMC events of ECB Presidents for two representative assets, the one-year OIS and the 10-year Italian sovereign yield. The figure shows the predicted 90 % predictive bands of both assets over a 90 and 115-minute window for different IMC event days and ECBGC meetings days, respectively, constructed as $1.65\sqrt{90\widehat{\sigma}_i^2 + 2\widehat{a}_i^2}$ and $1.65\sqrt{115\widehat{\sigma}_i^2 + 2\widehat{a}_i^2}$. The intraday predictive bands show considerable variation in both assets, in particular during the early and late parts of our sample, as well as during the Great Financial Crisis and the euro area Sovereign Debt Crisis. Overall, the intraday volatility of OIS1Y appears smaller than the sample average during the years in which the policy rates in the euro area have been close or at the effective lower bound.[29] The sizable and time-varying market volatility cautions against the common approach in the literature that uses no or constant thresholds throughout the sample

[29]The volatility is outside of the plot's scale for two ECBGC events, November 6, 2008, and March 16, 2023, due to large changes within a few minutes before the publication of the press release.

to assess the significance of asset movements around central bank communication.[30]

Figure C.2: Predictive bands for intraday changes over a typical event window



(a) OIS1Y, ECB President IMC

(b) OIS1Y, ECBGC

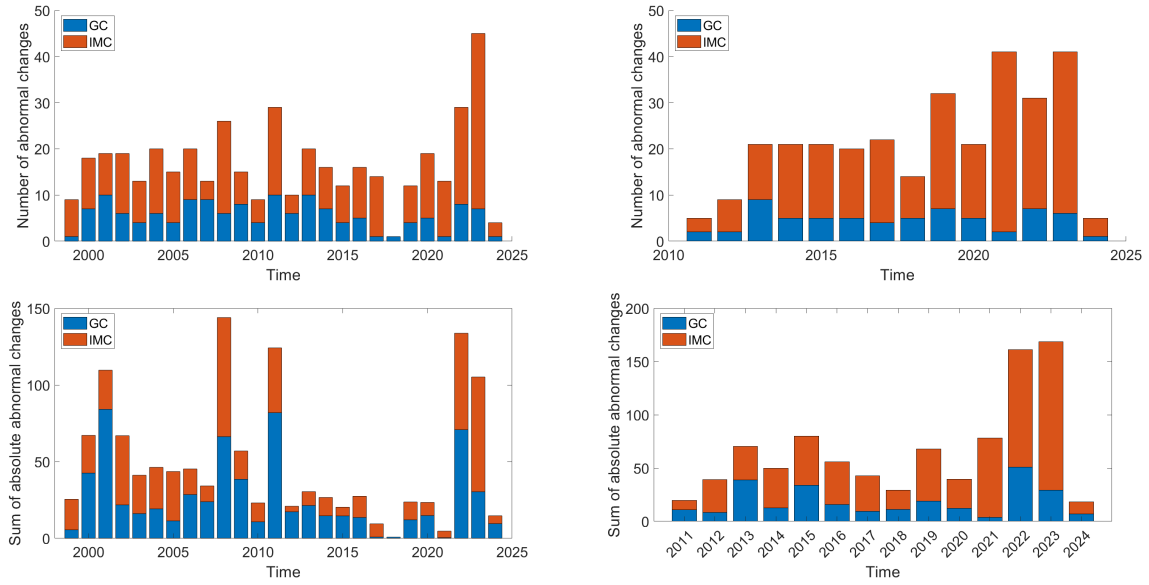
(c) ITA10Y, ECB President IMC

(d) ITA10Y, ECBGC

Note: The blue solid line shows the predicted 90 % predictive bands of OIS1Y and ITA10Y changes over a 90-minute window for different IMC event days and 115 minutes for ECBGC meetings days. The predictive bands are based on intraday volatilities that are estimated on quotes in the 120 minutes before the start of the event. The dashed orange line shows the average over the whole sample of the predictive bands.

[30]For instance, Bauer and Swanson (2023) consider in their sample of surprises around Fed chair speeches all the events that are easily identified as speaking about monetary policy or that lead to a movement of 3 basis point or more in the two-quarter-ahead Eurodollar futures contracts.

Figure C.3: Number and impact of communication events with abnormal returns over time



(a) OIS1Y (b) OIS10Y

Note: The top panel shows the number of communication events with abnormal returns over time and the bottom panel shows the sum of absolute abnormal returns. ECBGC stands for ECB Governing Council policy meeting events and IMC. Abnormal returns are calculated as described in the text. Results for 2024 are until February.

Appendix D Details on factor decomposition

The pvalues for the factors in table Tables 3 and 4, and elsehwere, are based on bootstrapped t statistics. In particular, we use a wild bootstrap to construct bootstrapped series, $X^{(j,b)}$ for $b = 1, ..., B$ with $B = 1000$, as follows

$$X^{(j,b)} = \widehat{F}^{(j)}\widehat{\Lambda}^{(j)} + \widehat{e}^{(j,b)}, \tag{9}$$

where the $\widehat{e}^{(j,b)}$ are a bootstrap sample obtained by re-sampling the error of the factor decomposition on the original data via wild bootstrap using the Rademacher distribution. A new series of factors is then extracted from $X^{(j,b)}$, the factors are rotated following the same logic as in the main text, $F^{(j,b)*}$. Then, a bootstrapped series of surprises $y_{t,i}^{(j,b)}$ is constructed using again a wild bootstrap based on a Rademacher

distribution as follows:

$$y_{t,i}^{(j,b)} = \widehat{\alpha}_i^{(j,k)} + \widehat{\beta}_i^{(j,k)} F_t^{(j,k)*} + u_{t,i}^{(j,k,b)}, \tag{10}$$

where the $\widehat{u}_{t,i}^{(j,k,b)}$ are a bootstrap sample obtained by re-sampling the error of the factor decomposition on the original data via wild bootstrap using the Rademacher distribution. Then, we run the regression

$$y_{t,i}^{(j,b)} = \alpha_i^{(j,k,b)} + \beta_i^{(j,k,b)} F_t^{(j,k,b)*} + u_{t,i}^{(j,k,b)}, \tag{11}$$

and obtain the bootstrap estimates of $\widehat{\beta}_i^{(j,k,b)}$. Since both the factors and the surprises are re-sampled the uncertainty about the factors and the coefficient estimates is reflected in the bootstrap sample of $\{\widehat{\beta}_i^{(j,k,b)}\}_{b=1}^{B}$. Bootstrap pvalues and t statistics are obtained following standard procedure.

D.1 Effect of factors on spreads

Table D.1 shows the effect of the identified factors on the term spread of German and Italian bonds as well as on the spread of German and Italian and German and Spanish bonds.

Table D.1: Effect of IMC and ECB GC factors on spreads

		10Y-2Y		Spread 10Y	
		DEU	ITA	ITA-DEU	SPA-DEU
		Panel A: Target factor			
IMC	β_i^j	-0.03	-0.06	-0.17	-0.08
	pval	(0.73)	(0.55)	(0.11)	(0.60)
	R2	0.00	0.00	0.01	0.00
ECBGC	β_i^j	**-1.77**	**-0.87**	0.55	0.03
	pval	(< 0.01)	(< 0.01)	(0.45)	(0.91)
	R2	0.22	0.04	0.01	0.00
		Panel B: FG factor			
IMC	β_i^j	-0.12	-0.04	-0.02	-0.12
	pval	(0.27)	(0.76)	(0.91)	(0.27)
	R2	0.01	0.00	0.00	0.00
ECBGC	β_i^j	**-2.06**	**-1.06**	**0.92**	0.33
	pval	(< 0.01)	(0.06)	(0.07)	(0.14)
	R2	0.30	0.06	0.02	0.01
		Panel C: QE factor			
IMC	β_i^j	**1.10**	**1.09**	**-0.39**	**-0.60**
	pval	(< 0.01)	(< 0.01)	(0.02)	(< 0.01)
	R2	0.47	0.25	0.03	0.05
ECBGC	β_i^j	**2.03**	**1.68**	-0.10	-0.30
	pval	(< 0.01)	(< 0.01)	(0.81)	(0.37)
	R2	0.29	0.16	0.00	0.00

Note: The table shows estimates of $\beta_i^{(j)}$ of eq. (3). Boldface numbers indicate significance at the 10% level. Numbers in parenthesis denote bootstrap p-values of a t-test for the null hypothesis that H_0 : $\beta = 0$. Numbers in the row $R2$ the R-squared of the regressions.

D.2 Factors estimated on larger set of IMC (GC) events

Results in the tables below are based on the factors extracted on a sample of $T_{\text{IMC}} = 1948$ and $T_{\text{GC}} = 272$. In other words, the sample is not based on the pre-selection mentioned in the main text but the sample contains events for which at least one OIS rate shows an abnormal return.

Table D.2: Effect of factors on OIS rates estimated on larger IMC (ECBGC) event set

		OIS								
		1M	3M	6M	1Y	2Y	3Y	5Y	7Y	10Y
		Panel A: Target factor								
IMC	β_i^j	**0.60**	**0.44**	**0.36**	**0.32**	**0.29**	**0.28**	**0.31**	**0.28**	**0.31**
	pval	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)
	R2	0.94	0.52	0.24	0.08	0.04	0.03	0.03	0.02	0.03
ECBGC	β_i^j	**4.07**	**3.34**	**2.73**	**2.11**	**1.43**	**1.12**	**0.80**	0.41	0.19
	pval	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(0.03)	(0.14)	(0.45)
	R2	0.97	0.82	0.58	0.29	0.12	0.07	0.04	0.01	0.00
		Panel B: FG factor								
IMC	β_i^j	0.00	**0.17**	**0.46**	**0.94**	**1.39**	**1.52**	**1.61**	**1.51**	**1.48**
	pval	(1.00)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)
	R2	-0.00	0.08	0.38	0.71	0.85	0.74	0.84	0.74	0.72
ECBGC	β_i^j	-0.00	**0.88**	**1.87**	**3.01**	**3.77**	**3.83**	**3.75**	**3.21**	**2.59**
	pval	(1.00)	(0.02)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)
	R2	0.00	0.06	0.27	0.59	0.82	0.86	0.90	0.88	0.74
		Panel C: QE factor								
IMC	β_i^j	0.00	**-0.28**	**-0.40**	**-0.40**	**-0.20**	0.02	**0.46**	**0.58**	**0.73**
	pval	(1.00)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(0.76)	(< 0.01)	(< 0.01)	(< 0.01)
	R2	0.00	0.21	0.30	0.13	0.02	0.00	0.07	0.11	0.17
ECBGC	β_i^j	-0.00	**-1.04**	**-1.25**	**-1.20**	-0.66	-0.15	0.74	**1.07**	**1.45**
	pval	(1.00)	(< 0.01)	(< 0.01)	(< 0.01)	(0.13)	(0.74)	(0.13)	(0.01)	(< 0.01)
	R2	0.00	0.08	0.12	0.10	0.02	0.00	0.03	0.10	0.23

Note: The table shows estimates of $\beta_i^{(j)}$ of eq. (3) on a larger set of IMC (ECBGC) event that avoids pre-selection of events as discussed in Section 4. Boldface numbers indicate significance at the 10% level. Numbers in parenthesis denote bootstrap p-values of a t-test for the null hypothesis that $H_0 : \beta_i^{(j)} = 0$. Numbers in the row *R2* show the R-squared of the regressions.

Table D.3: Effect of factors on sovereign yields estimated on larger IMC (GC) event set

		DEU2Y	ITA2Y	SPA2Y	DEU10Y	ITA10Y	SPA10Y	Eurostoxx50
					Panel A: Target factor			
IMC	β_i^j	**0.26**	0.06	0.01	**0.31**	**0.13**	**0.22**	**1.78**
	pval	(< 0.01)	(0.54)	(0.91)	(< 0.01)	(0.01)	(< 0.01)	(< 0.01)
	R2	0.02	0.00	0.00	0.03	0.00	0.01	0.02
ECBGC	β_i^j	**1.39**	1.99	**1.95**	0.13	1.08	0.80	**-0.13**
	pval	(< 0.01)	(0.10)	(0.05)	(0.62)	(0.22)	(0.35)	(0.02)
	R2	0.09	0.03	0.04	0.00	0.01	0.01	0.03
					Panel B: FG factor			
IMC	β_i^j	**1.55**	**1.33**	**1.19**	**1.55**	**1.38**	**1.32**	**2.56**
	pval	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)
	R2	0.62	0.16	0.18	0.68	0.25	0.21	0.03
ECBGC	β_i^j	**4.12**	**3.73**	**3.14**	**2.90**	**3.28**	**2.91**	**-0.16**
	pval	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(0.01)
	R2	0.79	0.11	0.09	0.72	0.13	0.13	0.05
					Panel C: QE factor			
IMC	β_i^j	0.03	**-0.22**	-0.13	**0.75**	**0.35**	**0.41**	**1.13**
	pval	(0.72)	(0.08)	(0.26)	(< 0.01)	(< 0.01)	(< 0.01)	(0.09)
	R2	0.00	0.00	0.00	0.16	0.02	0.02	0.01
ECBGC	β_i^j	-0.66	-0.52	-1.99	**1.55**	1.42	0.75	0.01
	pval	(0.20)	(0.83)	(0.57)	(< 0.01)	(0.34)	(0.65)	(0.88)
	R2	0.02	0.00	0.04	0.21	0.02	0.01	0.00

Note: The table shows estimates of $\beta_i^{(j)}$ of eq. (3) on a larger set of IMC (ECBGC) event that avoids pre-selection of events as discussed in Section 4. Boldface numbers indicate significance at the 10% level. Numbers in parenthesis denote bootstrap p-values of a t-test for the null hypothesis that $H_0 : \beta = 0$. Numbers in the row *R*2 show the R-squared of the regressions.

Table D.4: Effect of factors on Spreads rates estimated on larger IMC (GC) event set

		10Y-2Y		Spread 10Y	
		DEU	ITA	ITA-DEU	SPA-DEU
		Panel A: Target factor			
IMC	β_i^j	0.04	0.06	**-0.16**	-0.08
	pval	(0.46)	(0.29)	(0.01)	(0.29)
	R2	0.00	0.00	0.00	0.00
ECBGC	β_i^j	**-1.26**	**-0.83**	1.13	0.67
	pval	(< 0.01)	(< 0.01)	(0.23)	(0.35)
	R2	0.15	0.03	0.02	0.01
		Panel B: FG factor			
IMC	β_i^j	-0.01	0.07	**-0.18**	**-0.22**
	pval	(0.87)	(0.37)	(< 0.01)	(< 0.01)
	R2	0.00	0.00	0.01	0.01
ECBGC	β_i^j	**-1.22**	-0.39	0.41	0.01
	pval	(< 0.01)	(0.46)	(0.60)	(0.98)
	R2	0.14	0.01	0.00	0.00
		Panel C: QE factor			
IMC	β_i^j	**0.70**	**0.58**	**-0.38**	**-0.33**
	pval	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)
	R2	0.22	0.06	0.02	0.02
ECBGC	β_i^j	**2.21**	**2.04**	-0.13	-0.81
	pval	(< 0.01)	(< 0.01)	(0.95)	(0.71)
	R2	0.45	0.20	0.00	0.01

Note: The table shows estimates of $\beta_i^{(j)}$ of eq. (3) on a larger set of IMC (ECBGC) event that avoids pre-selection of events as discussed in Section 4. Boldface numbers indicate significance at the 10% level. Numbers in parenthesis denote bootstrap p-values of a t-test for the null hypothesis that $H_0 : \beta_i^{(j)} = 0$. Numbers in the row $R2$ show the R-squared of the regressions.

Appendix E Macroeconomic effects of monetary policy

E.1 Narrative sign restrictions based on Governing Council meetings

The narrative sign restrictions based on Governing Council were selected following the same logic as for the IMC-NSR1 to IMC-NSR4 based on IMC in the main text. When combining the narrative sign restrictions of GC and NSR, we used NSR1, NSR2, NSR3, NSRGC1, and NSRGC3.

Narrative Sign Restriction GC1 (NSRGC1) *The monetary policy shock has a negative sign in October 2022.*

Narrative Sign Restriction GC2 (NSRGC2) *The monetary policy shock has a negative sign in October 2022.*

Narrative Sign Restriction GC3 (NSRGC3) *The monetary policy shock has a positive sign in December 2022.*

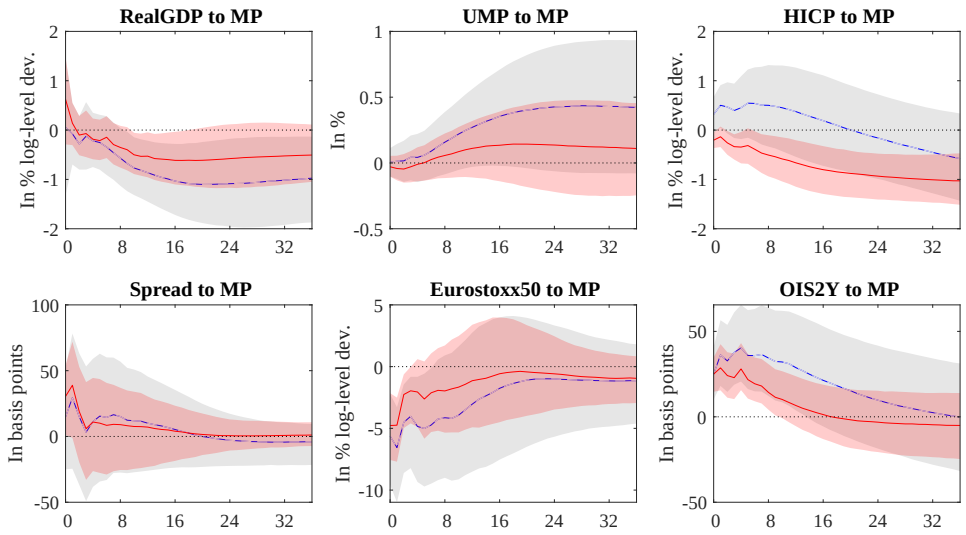
Narrative Sign Restriction GC4 (NSRGC4) *The monetary policy shock has a negative sign in July 2008.*

Figure E.1 shows IRFs based on sign restrictions (dashed line, grey shaded areas) and IRFs based on sign restrictions in combination with narrative sign restrictions (solid line, red shaded areas) based on Governing Council dates alone. The solid lines show the IRFs when using the baseline sign restrictions + NSRGC1 to NSRGC4 to identify the monetary policy shock and the dashed line shows the IRFs when using only the baseline sign restrictions. We observe that narrative restrictions help to narrow the credibility interval and resolve the price puzzle from the BVAR with sign restrictions alone. However, the response of the unemployment rate and of the spread remains insignificant. In addition, the reaction of real GDP on impact has a positive sign.

The results in Figure E.2 shows results when using sign restrictions in combination with narrative sign restrictions of both IMC and GC (dashed line, grey shaded areas), NSR1, NSR2, NSR3, NSRGC1, and NSRGC3, and results based on sign restrictions

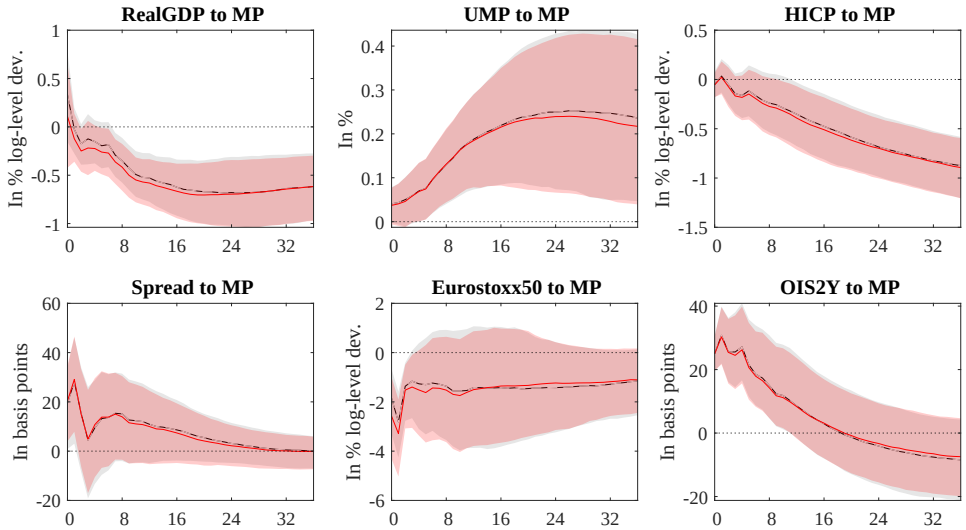
in combination with IMC-based narrative sign restrictions IMC-NSR1 to IMC-NSR4 (solid line, red shaded area). The results suggest that taking into account both IMC and GC related surprises leads to IRFs that are similar to the IRFs based on just IMC alone.

Figure E.1: Baseline sign restrictions vs GC NSR



Note: The dashed line shows the posterior median of the IRFs to a 25 bps monetary policy shock with the sign restrictions on the OIS2Y and the Eurostoxx50 index. The dashed line shows the posterior median of the IRFs to a 25 bps monetary policy shock with the sign restrictions on the OIS2Y and the Eurostoxx50 index and the GC-based narrative sign restrictions NSRGC1 to NSRGC4. Grey and red shaded areas show the 68% credible sets.

Figure E.2: GC & IMC NSR vs IMC NSR



Note: The dashed line shows the posterior median of the IRFs to a 25 bps monetary policy shock with the sign restrictions on the OIS2Y and the Eurostoxx50 index and the GC-based (10/2022, 12/2022) & IMC-based (11/2005, 06/2019) narrative sign restrictions. The dashed line shows the posterior median of the IRFs to a 25 bps monetary policy shock with the sign restrictions on the OIS2Y and the Eurostoxx50 index and the IMC-based narrative sign restrictions IMC-NSR1 to IMC-NSR4, as discussed in the main text. Grey and red shaded areas show the 68% credible sets.

E.2 Robustness for the BVAR results

Figure E.3 shows that results are robust when substituting the OIS2Y with the shadow rate based on Krippner (2013, 2015), available for download: https://www.ljkmfa.com/.

Figure E.4 shows the results when replacing real GDP with industrial production in the BVAR model. Results are robust, although the credibility interval for industrial production are wider than for the real GDP.

Figure E.5 shows the results when the sign restriction on the response of the OIS2Y is imposed only on impact and three additional months instead of seven additional months.

Figure E.6 show results when imposing tighter sign restrictions compared to the baseline SR&NSR restrictions. In particular, the tighter sign restriction impose that the IRF of the OIS2Y must increase in the first five periods, the IRF of real GDP and HICP must decrease in period three, four and, five periods after the shock, the IRF of the Eurostoxx50 must decrease in the first three periods and the IRF of the HICP must decrease in period three, four, and five. Note that these sign restrictions are

considerably tight and completely restrict the qualitative effect of a monetary policy shock. Interestingly, the SR&NSR model with much less restrictive assumptions leads to qualitatively and quantitatively very similar results. In addition, the SR&NSR model leads to tighter credible sets.

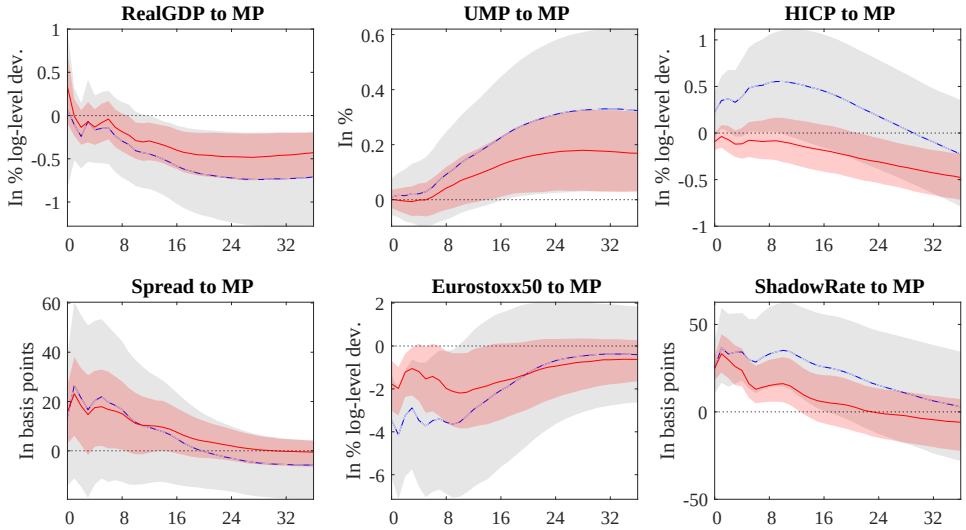
Figure E.7 and Figure E.8 show results when using a lag length of nine and 12, respectively, instead of six lags. Results are qualitatively robust although the credible intervals are lightly wider for both real GDP and the unemployment rate.

Figure E.9 shows the results when using a Minnesota prior similar to Littermann (1979), i.e., shrinking all first own-lags to one and all other coefficients in B to zero. The tightness of the prior on the lags is set to 0.2 and the lag-decaying parameter is set to 2. Results are very similar to the baseline results.

Figure E.10 shows results when using 12 lags and the Minnesota prior as in Figure E.9. Results are similar to the baseline specification in the main text and suggest that when using 12 lags, a somewhat tighter prior specification that a flat prior might be required due to parameter proliferation.

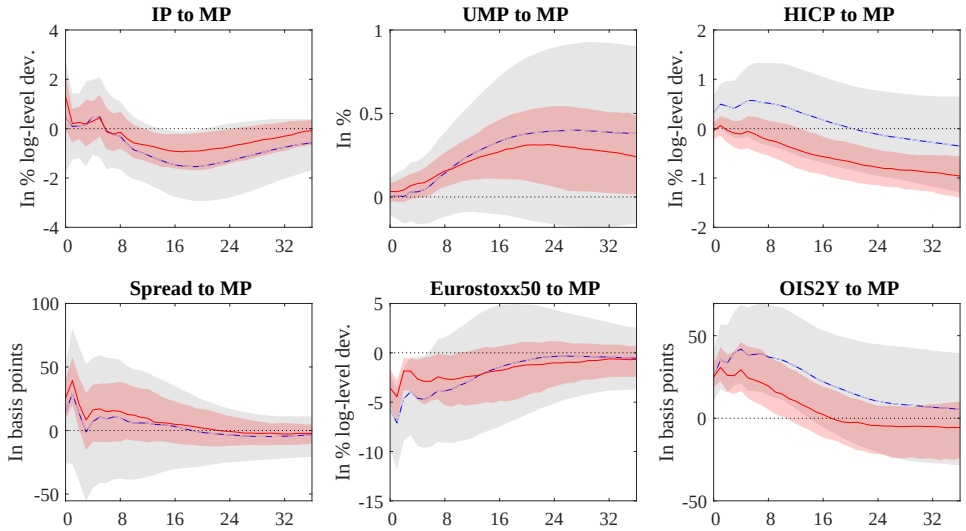
Figure E.11 shows the results when using a Minnesota prior refined with a dummy-initial-observation prior. The tightness of the dummy-initial-observation prior is set to one, a standard value in the literature. Results are very similar to the baseline result.

Figure E.3: Replacing the OIS2Y with the shadow rate



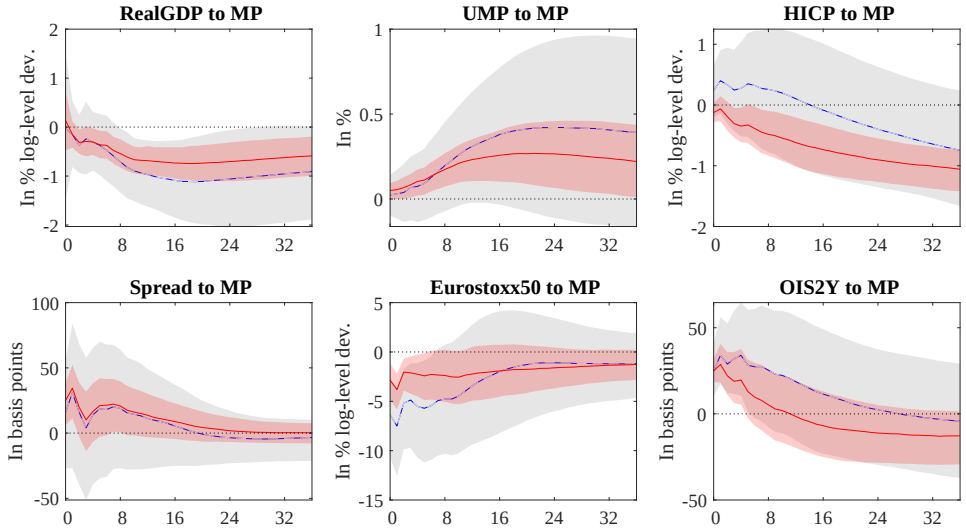
Note: The blue line shows the posterior median of the IRFs to a monetary policy shock with the sign restrictions on the shadow rate and the Eurostoxx50 index. The red line shows the posterior median of the IRFs when using the sign + narrative sign restrictions IMC-NSR1 to IMC-NSR4. Grey and red shaded areas show the 68% credible sets.

Figure E.4: Replacing real GDP with industrial production



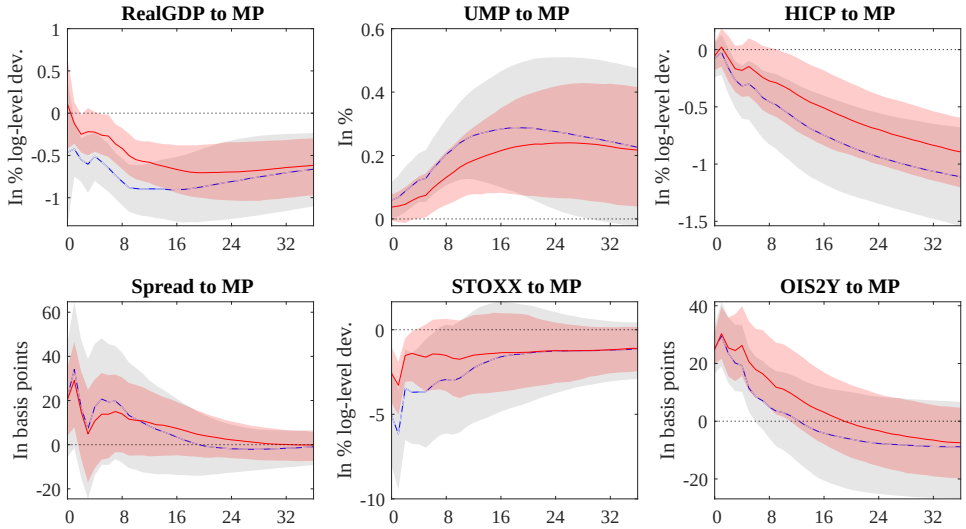
Note: The blue line shows the posterior median of the IRFs to a monetary policy shock with sign restrictions on the OIS2Y and the Eurostoxx50 index. The red line shows the posterior median of the IRFs when using the sign + narrative sign restrictions IMC-NSR1 to IMC-NSR4. Grey and red shaded areas show the 68% credible sets.

Figure E.5: Sign restrictions for OIS2Y on impact and three additional months only



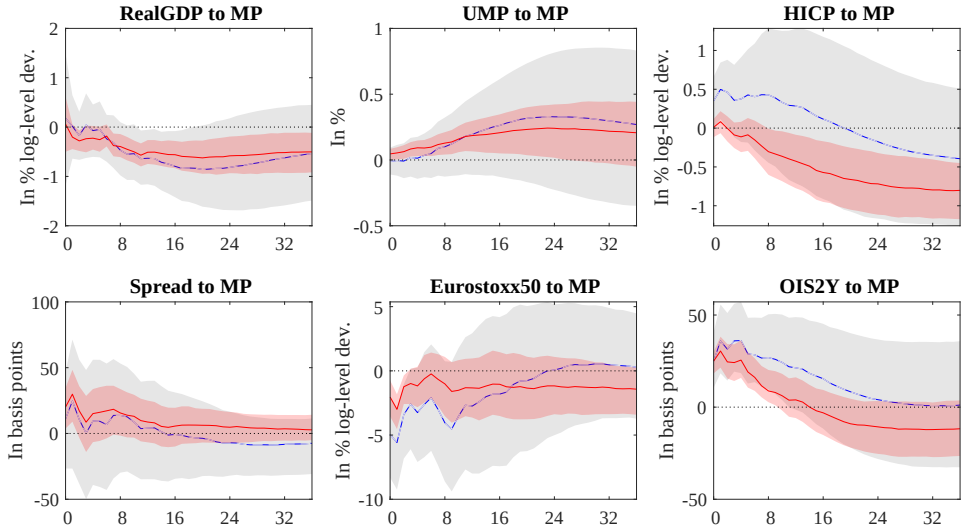
Note: The blue line shows the posterior median of the IRFs to a monetary policy shock with sign restrictions on the OIS2Y and the Eurostoxx50 index for three periods. The red line shows the posterior median of the IRFs when using the baseline sign + narrative sign restrictions IMC-NSR1 to IMC-NSR4. Grey and red shaded areas show the 68% credible sets.

Figure E.6: Baseline sign & narrative restrictions vs tighter sign restrictions



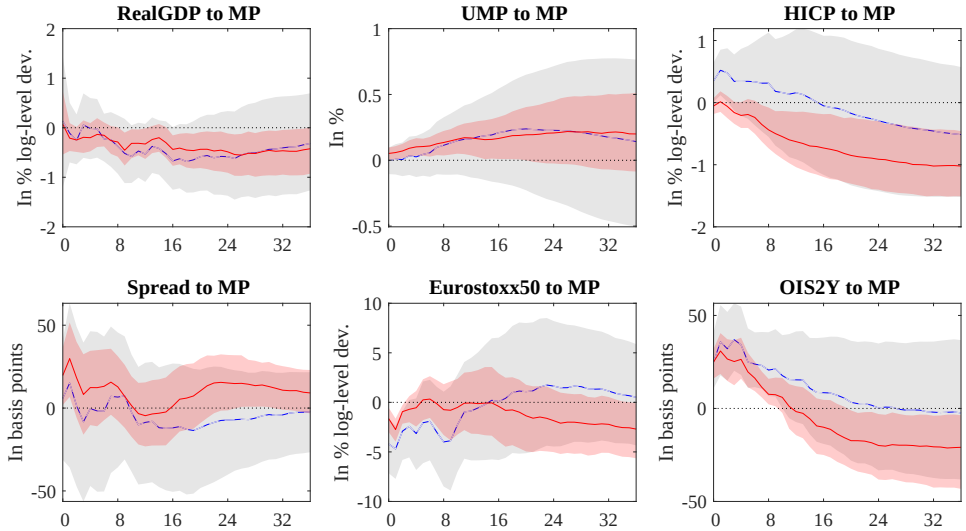
Note: The blue line shows the posterior median of the IRFs to a monetary policy shock with the sign restrictions on the OIS2Y, real GDP, the unemployment rate, the HICP, and the Eurostoxx50 index. The red line shows the posterior median of the IRFs when using the baseline sign + narrative sign restrictions IMC-NSR1 to IMC-NSR4. Grey and red shaded areas show the 68% credible sets.

Figure E.7: Lag length of nine instead of six



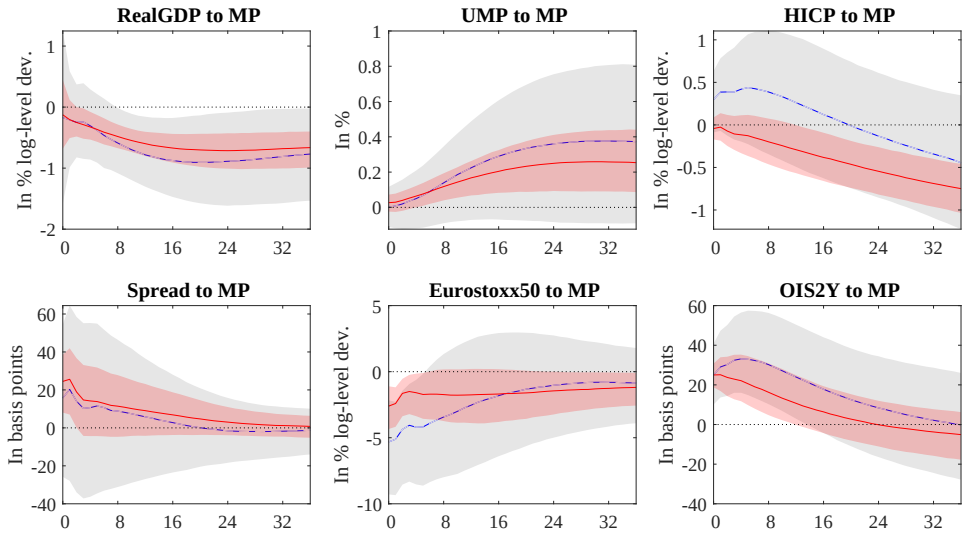
Note: The blue line shows the posterior median of the IRFs to a monetary policy shock with the sign restrictions on the OIS2Y and the Eurostoxx50 index. The red line shows the posterior median of the IRFs when using the sign + narrative sign restrictions IMC-NSR1 to IMC-NSR4. Grey and red shaded areas show the 68% credible sets.

Figure E.8: Lag length of 12 instead of six



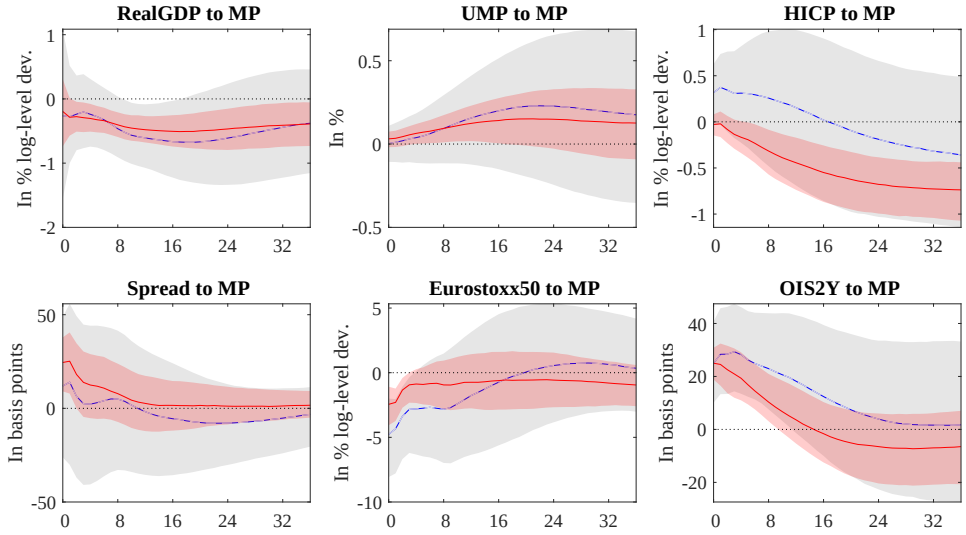
Note: The blue line shows the posterior median of the IRFs to a monetary policy shock with the sign restrictions on the OIS2Y and the Eurostoxx50 index. The red line shows the posterior median of the IRFs when using the sign + narrative sign restrictions IMC-NSR1 to IMC-NSR4. Grey and red shaded areas show the 68% credible sets.

Figure E.9: Minnesota prior instead of flat prior



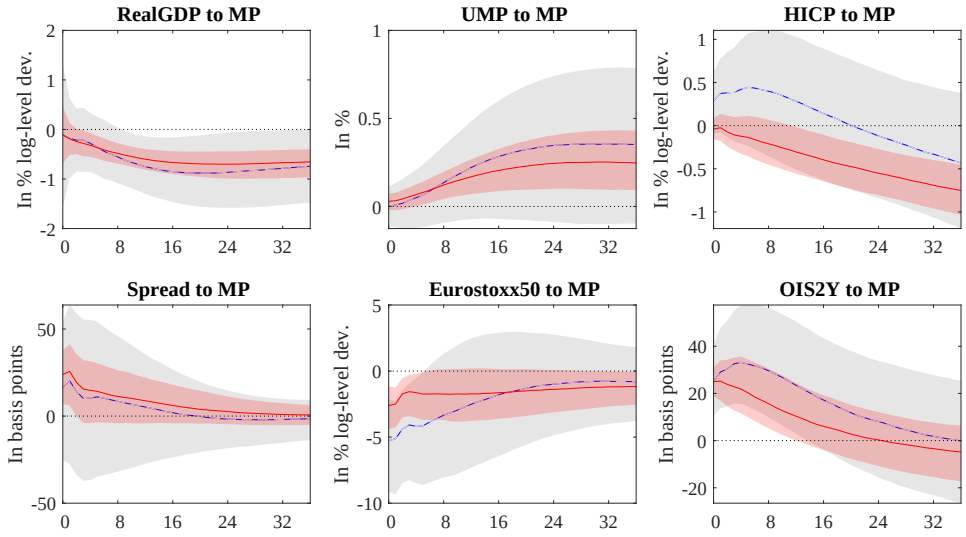
Note: The blue line shows the posterior median of the IRFs to a monetary policy shock with the sign restrictions on the OIS2Y and the Eurostoxx50 index. The red line shows the posterior median of the IRFs when using the sign + narrative sign restrictions IMC-NSR1 to IMC-NSR4. Grey and red shaded areas show the 68% credible sets.

Figure E.10: Lag length of 12 instead of six and Minnesota prior



Note: The blue line shows the posterior median of the IRFs to a monetary policy shock with the sign restrictions on the OIS2Y and the Eurostoxx50 index. The red line shows the posterior median of the IRFs when using the sign + narrative sign restrictions IMC-NSR1 to IMC-NSR4. Grey and red shaded areas show the 68% credible sets.

Figure E.11: Minnesota prior with dummy-initial-observations

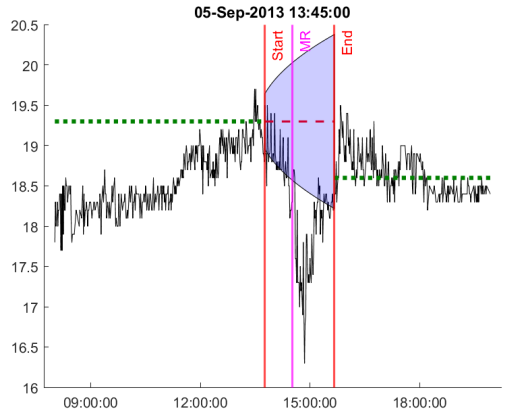


Note: The blue line shows the posterior median of the IRFs to a monetary policy shock with the sign restrictions on the OIS2Y and the Stoxx index. The red line shows the posterior median of the IRFs when using the sign + narrative sign restrictions IMC-NSR1 to IMC-NSR4. Grey and red shaded areas show the 68% credible sets.

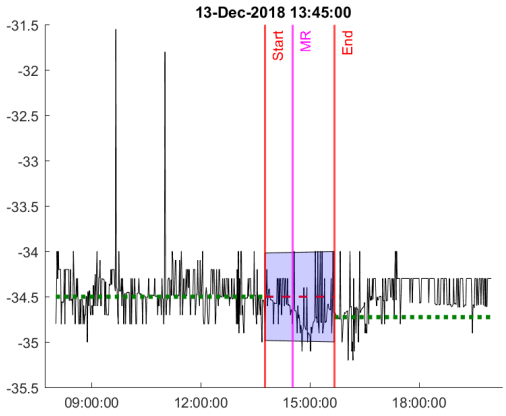
Appendix F Additional results on high-frequency abnormal returns

F.1 Events with insignificant returns

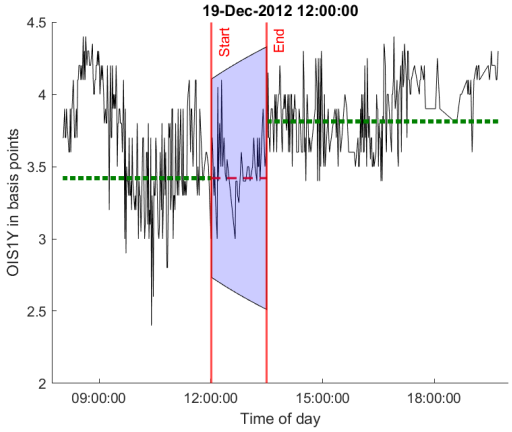
Figure F.1: Examples of events with non-abnormal returns



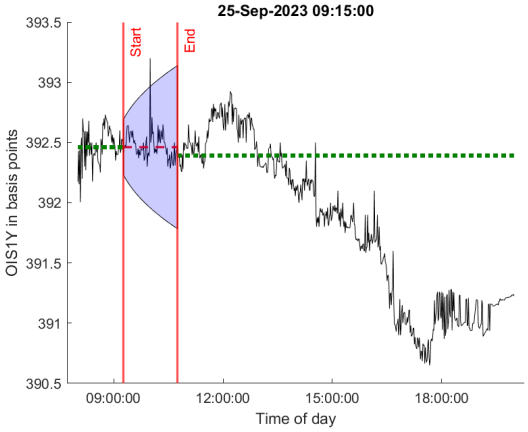
(a) GC meeting, September 5, 2013



(b) GC meeting, December 13, 2018



(c) ECB Board: Asmussen, December 19, 2012



(d) NCB: De Cos, September 25, 2019

Note: Note: The solid line shows the minute-by-minute quotes of the OIS1Y in basis points. The vertical lines with the label "Start" and "End" show the start and end of the 90-minute IMC event window, respectively. Vertical lines with the label "MR" show the release of macro data by statistical agencies. The dashed lines show the mean of the quotes in the 15-minute (10-minute for GC) pre-event window and the 15-minute (10-minute for GC) post-event window, respectively. The shaded areas show the predictive intervals based on the intraday variance estimated on data up to the event.

F.2 Impact of events without controlling for significance of returns

Table F.1: Importance of Eurosystem communication events - OIS and Eurostoxx50

	OIS									Eurostoxx50
	1999-2024					2002-2024	2011-2024			1999-2024
Events	1M	3M	6M	1Y	2Y	3Y	5Y	7Y	10Y	
	Panel A: cumulative impact									
ECBGC	495	521	599	770	840	686	360	339	313	136
ECB President	129	181	263	407	570	570	317	349	372	140
ECB EB	349	521	723	1166	1595	1624	1128	1222	1376	465
NCBs	272	398	574	934	1353	1292	833	884	962	317
EP hearing	16	29	76	108	126	86	39	42	47	21
Accounts	4	9	9	18	29	39	43	44	47	9
Interviews	25	37	68	117	167	174	172	170	180	23
	Panel B: impact per event									
ECBGC	1.97	2.00	2.28	2.93	3.32	3.19	3.13	2.90	2.68	0.52
ECB President	0.34	0.36	0.45	0.68	0.95	1.11	1.06	1.16	1.22	0.34
ECB EB	0.26	0.31	0.37	0.57	0.80	0.95	0.90	0.97	1.07	0.31
NCBs	0.30	0.35	0.43	0.67	0.98	1.11	1.02	1.06	1.14	0.32
EP hearing	0.31	0.40	0.83	1.10	1.29	1.17	0.84	0.89	1.01	0.45
Accounts	0.07	0.15	0.14	0.28	0.44	0.60	0.67	0.67	0.72	0.13
Interviews	0.24	0.32	0.53	0.87	1.27	1.49	1.72	1.70	1.74	0.32

Note: Panel A shows the cumulative impact of absolute asset price changes for respective communication events on the OIS, one-month to 10-year maturity and on the Eurostoxx50. Panel B shows the average absolute impact. ECBGC refers to ECB Governing Council monetary policy announcement events. Rows from ECB president to EP hearing, refer to speaking events in the inter-meeting period, for the ECB president, the ECB Executive Board (EB) members, the governors of the national central banks (NCBs) of Germany, France, Italy and Spain, and the European Parliament (EP) hearings of the ECB president. Accounts refers to ECB Monetary Policy Accounts and Interviews to the communication event through interviews of ECB Executive Board members (including the ECB president) and selected NCB governors. All numbers denote basis point changes for the OIS and returns in the case of the Eurostoxx50. Numbers are rounded to the nearest integer in Panel A and rounded to the second decimal in Panel B.

F.3 Number of abnormal returns when using fixed threshold

Table F.2: Number of communication events that lead to abnormal returns - threshold of 3bps

	OIS									Eurostoxx50
	1999-2024					2002-2024	2011-2024			1999-2024
Events	1M	3M	6M	1Y	2Y	3Y	5Y	7Y	10Y	
ECBGC	48	52	65	83	95	80	47	45	45	106
	(16 %)	(17 %)	(21 %)	(27 %)	(31 %)	(26 %)	(15 %)	(15 %)	(15 %)	(35 %)
ECB President	5	6	9	14	29	34	16	16	20	55
	(1 %)	(1 %)	(2 %)	(2 %)	(5 %)	(7 %)	(6 %)	(6 %)	(7 %)	(14 %)
ECB EB	5	12	10	37	70	79	53	46	73	219
	(0 %)	(1 %)	(1 %)	(2 %)	(4 %)	(5 %)	(4 %)	(4 %)	(6 %)	(15 %)
NCBs	7	5	14	41	84	80	46	47	52	154
	(1 %)	(0 %)	(1 %)	(3 %)	(6 %)	(7 %)	(6 %)	(6 %)	(6 %)	(16 %)
EP hearing	0	1	4	8	12	6	1	1	2	10
	(0 %)	(1 %)	(4 %)	(8 %)	(12 %)	(8 %)	(2 %)	(2 %)	(4 %)	(21 %)
Accounts	0	0	0	0	1	1	2	2	2	1
	(0 %)	(0 %)	(0 %)	(0 %)	(2 %)	(2 %)	(3 %)	(3 %)	(3 %)	(2 %)
Interviews	1	2	3	8	13	16	16	13	18	14
	(1 %)	(2 %)	(2 %)	(6 %)	(10 %)	(14 %)	(16 %)	(13 %)	(17 %)	(19 %)

Note: The selection of what constitutes an abnormal return is based on a fixed threshold of 3bps. For each event type, the first row shows the total number of events with abnormal returns, that is, events that actually surprised markets, and the second row shows the events with abnormal returns as a percentage of all events for this asset for which we can compute high-frequency changes. ECBGC refers to ECB Governing Council monetary policy announcement events. Rows from ECB president to EP hearing, refer to speaking events in the inter-meeting period, from the ECB president, the ECB Executive Board (EB) members, the governors of the NCBs of Germany, France, Italy and Spain, and the European Parliament (EP) hearings of the ECB president. Accounts refers to ECB Monetary Policy Accounts and Interview to the communication through interviews of ECB Executive Board members (including the ECB president) and selected NCB governors.

F.4 Abnormal returns for sovereign yields, FX and ILS

Table F.3: Communication events that lead to abnormal returns - DEU

Announcement	3M	6M	1Y	2Y	3Y	5Y	7Y	10Y
ECBGC	26	55	94	149	148	164	156	147
	(9 %)	(18 %)	(31 %)	(49 %)	(49 %)	(54 %)	(51 %)	(48 %)
ECB President	15	17	27	64	84	82	88	85
	(10 %)	(7 %)	(7 %)	(12 %)	(14 %)	(14 %)	(15 %)	(15 %)
ECB EB	30	45	65	188	213	244	226	232
	(5 %)	(6 %)	(5 %)	(10 %)	(11 %)	(12 %)	(11 %)	(12 %)
NCBs	24	44	60	139	156	194	197	188
	(6 %)	(8 %)	(7 %)	(11 %)	(11 %)	(14 %)	(14 %)	(14 %)
EP hearing	1	2	5	27	25	24	24	23
	(11 %)	(10 %)	(10 %)	(34 %)	(25 %)	(24 %)	(24 %)	(24 %)
Accounts	1	1	3	6	7	7	10	10
	(3 %)	(2 %)	(6 %)	(10 %)	(11 %)	(11 %)	(15 %)	(15 %)
Interview	1	1	7	8	12	16	17	17
	(2 %)	(2 %)	(9 %)	(7 %)	(9 %)	(12 %)	(13 %)	(13 %)

Note: For each event type, the first row shows the total number of events with abnormal returns, that is, events that actually surprised markets, and the second row shows the events with abnormal returns as a percentage of all events for this asset for which we can compute high-frequency changes. ECBGC refers to ECB Governing Council monetary policy announcement events. Rows from ECB president to EP hearing, refer to speaking events in the inter-meeting period, from the ECB president, the ECB Executive Board (EB) members, the governors of the NCBs of Germany, France, Italy and Spain, and the European Parliament (EP) hearings of the ECB president. Accounts refers to ECB Monetary Policy Accounts and Interview to the communication through interviews of ECB Executive Board members (including the ECB president) and selected NCB governors.

Table F.4: Communication events that lead to abnormal returns - FRA

Announcement	3M	6M	1Y	2Y	3Y	5Y	7Y	10Y
ECBGC	69	93	126	136	145	160	148	152
	(23 %)	(30 %)	(41 %)	(45 %)	(48 %)	(52 %)	(49 %)	(50 %)
ECB President	11	24	40	62	79	74	85	86
	(7 %)	(8 %)	(12 %)	(11 %)	(13 %)	(13 %)	(14 %)	(15 %)
ECB EB	31	57	96	150	201	234	241	215
	(6 %)	(6 %)	(8 %)	(8 %)	(10 %)	(12 %)	(12 %)	(11 %)
NCBs	25	37	72	126	143	177	166	171
	(7 %)	(6 %)	(9 %)	(9 %)	(11 %)	(13 %)	(12 %)	(13 %)
EP hearing	0	6	15	22	22	22	26	23
	(0 %)	(16 %)	(33 %)	(22 %)	(22 %)	(24 %)	(26 %)	(24 %)
Accounts	0	0	3	4	7	6	8	8
	(0 %)	(0 %)	(7 %)	(6 %)	(11 %)	(9 %)	(12 %)	(12 %)
Interview	1	3	4	8	15	15	19	14
	(2 %)	(5 %)	(6 %)	(6 %)	(12 %)	(12 %)	(15 %)	(11 %)

Note: For each event type, the first row shows the total number of events with abnormal returns, that is, events that actually surprised markets, and the second row shows the events with abnormal returns as a percentage of all events for this asset for which we can compute high-frequency changes. ECBGC refers to ECB Governing Council monetary policy announcement events. Rows from ECB president to EP hearing, refer to speaking events in the inter-meeting period, from the ECB president, the ECB Executive Board (EB) members, the governors of the NCBs of Germany, France, Italy and Spain, and the European Parliament (EP) hearings of the ECB president. Accounts refers to ECB Monetary Policy Accounts and Interview to the communication through interviews of ECB Executive Board members (including the ECB president) and selected NCB governors.

Table F.5: Communication events that lead to abnormal returns - ITA

Announcement	3M	6M	1Y	2Y	3Y	5Y	7Y	10Y
ECBGC	17	35	48	127	127	140	129	130
	(6 %)	(11 %)	(16 %)	(42 %)	(42 %)	(46 %)	(42 %)	(43 %)
ECB President	10	15	18	73	78	98	104	107
	(7 %)	(9 %)	(8 %)	(14 %)	(15 %)	(18 %)	(19 %)	(20 %)
ECB EB	37	45	62	192	239	288	298	267
	(6 %)	(7 %)	(8 %)	(11 %)	(14 %)	(17 %)	(17 %)	(15 %)
NCBs	19	25	43	137	164	217	233	207
	(4 %)	(5 %)	(8 %)	(11 %)	(14 %)	(18 %)	(18 %)	(17 %)
EP hearing	0	2	6	19	21	22	20	23
	(0 %)	(13 %)	(27 %)	(24 %)	(27 %)	(27 %)	(24 %)	(27 %)
Accounts	0	1	1	8	9	14	14	12
	(0 %)	(3 %)	(2 %)	(12 %)	(14 %)	(22 %)	(22 %)	(18 %)
Interview	2	1	2	13	15	16	18	20
	(3 %)	(2 %)	(3 %)	(11 %)	(13 %)	(14 %)	(15 %)	(17 %)

Note: For each event type, the first row shows the total number of events with abnormal returns, that is, events that actually surprised markets, and the second row shows the events with abnormal returns as a percentage of all events for this asset for which we can compute high-frequency changes. ECBGC refers to ECB Governing Council monetary policy announcement events. Rows from ECB president to EP hearing, refer to speaking events in the inter-meeting period, from the ECB president, the ECB Executive Board (EB) members, the governors of the NCBs of Germany, France, Italy and Spain, and the European Parliament (EP) hearings of the ECB president. Accounts refers to ECB Monetary Policy Accounts and Interview to the communication through interviews of ECB Executive Board members (including the ECB president) and selected NCB governors.

Table F.6: Communication events that lead to abnormal returns - ESP

Announcement	3M	6M	1Y	2Y	3Y	5Y	7Y	10Y
ECBGC	24	37	37	120	151	147	144	149
	(8 %)	(12 %)	(12 %)	(39 %)	(50 %)	(48 %)	(47 %)	(49 %)
ECB President	4	9	15	62	85	103	119	119
	(4 %)	(6 %)	(8 %)	(11 %)	(15 %)	(18 %)	(20 %)	(21 %)
ECB EB	19	51	63	170	238	309	339	321
	(4 %)	(8 %)	(8 %)	(9 %)	(12 %)	(16 %)	(17 %)	(17 %)
NCBs	16	28	43	133	160	236	228	241
	(5 %)	(7 %)	(8 %)	(10 %)	(12 %)	(18 %)	(17 %)	(18 %)
EP hearing	0	2	3	21	26	25	24	20
	(0 %)	(18 %)	(14 %)	(23 %)	(29 %)	(28 %)	(26 %)	(22 %)
Accounts	1	1	4	5	6	12	14	12
	(4 %)	(3 %)	(11 %)	(8 %)	(9 %)	(18 %)	(22 %)	(19 %)
Interview	0	2	5	16	13	21	20	19
	(0 %)	(3 %)	(7 %)	(12 %)	(10 %)	(17 %)	(15 %)	(15 %)

Note: For each event type, the first row shows the total number of events with abnormal returns, that is, events that actually surprised markets, and the second row shows the events with abnormal returns as a percentage of all events for this asset for which we can compute high-frequency changes. ECBGC refers to ECB Governing Council monetary policy announcement events. Rows from ECB president to EP hearing, refer to speaking events in the inter-meeting period, from the ECB president, the ECB Executive Board (EB) members, the governors of the NCBs of Germany, France, Italy and Spain, and the European Parliament (EP) hearings of the ECB president. Accounts refers to ECB Monetary Policy Accounts and Interview to the communication through interviews of ECB Executive Board members (including the ECB president) and selected NCB governors.

Table F.7: Communication events that lead to abnormal returns - ILS

Announcement	FX	1Y	2Y	5Y	10Y
	Panel A: total impact				
ECBGC	153	11	12	18	16
	(50 %)	(4 %)	(4 %)	(6 %)	(5 %)
ECB President	91	9	6	5	5
	(15 %)	(12 %)	(8 %)	(7 %)	(9 %)
ECB EB	255	14	12	11	9
	(12 %)	(6 %)	(5 %)	(5 %)	(5 %)
NCBs	171	9	9	9	12
	(12 %)	(6 %)	(6 %)	(7 %)	(10 %)
EP hearing	23	0	0	0	0
	(21 %)	(0 %)	(0 %)	(0 %)	(0 %)
Accounts	10	0	0	0	0
	(15 %)	(0 %)	(0 %)	(0 %)	(0 %)
Interview	11	1	1	0	0
	(8 %)	(7 %)	(6 %)	(0 %)	(0 %)

Note: For each event type, the first row shows the total number of events with abnormal returns, that is, events that actually surprised markets, and the second row shows the events with abnormal returns as a percentage of all events for this asset for which we can compute high-frequency changes. ECBGC refers to ECB Governing Council monetary policy announcement events. Rows from ECB president to EP hearing, refer to speaking events in the inter-meeting period, from the ECB president, the ECB Executive Board (EB) members, the governors of the NCBs of Germany, France, Italy and Spain, and the European Parliament (EP) hearings of the ECB president. Accounts refers to ECB Monetary Policy Accounts and Interview to the communication through interviews of ECB Executive Board members (including the ECB president) and selected NCB governors.

Table F.8: Importance of events that lead to abnormal returns - DEU

Event	3M	6M	1Y	2Y	3Y	5Y	7Y	10Y
	Panel A: total impact							
ECBGC	385	228	403	808	789	797	680	581
ECB President	43	59	94	176	247	260	269	278
ECB EB	131	145	111	456	498	666	643	694
NCBs	82	104	156	416	461	602	570	576
EP hearing	4	3	14	90	80	74	69	61
Accounts	2	1	7	17	19	18	23	21
Interviews	1	4	23	29	41	51	54	53
	Panel B: impact per event							
ECBGC	15.41	4.14	4.29	5.42	5.33	4.86	4.36	3.95
ECB President	2.88	3.48	3.47	2.75	2.94	3.17	3.06	3.27
ECB EB	4.37	3.23	1.71	2.41	2.34	2.72	2.85	2.98
NCBs	3.42	2.36	2.61	2.99	2.95	3.10	2.89	3.06
EP hearing	4.45	1.51	2.79	3.33	3.18	3.10	2.89	2.67
Accounts	1.63	0.65	2.24	2.88	2.76	2.60	2.28	2.09
Interviews	0.60	3.75	3.23	3.58	3.42	3.19	3.16	3.14

Note: Panel A shows the cumulative impact of absolute surprises for all events with abnormal returns in the German government bond yield, for maturities of three months up to 10 years. Panel B shows the average absolute impact. ECBGC refers to ECB Governing Council monetary policy announcement events. Rows from ECB President to EP hearing, refer to speaking events in the inter-meeting period, from the ECB president, the ECB Executive Board (EB) members, the governors of the national central banks (NCBs) of Germany, France, Italy and Spain, and the European Parliament (EP) hearings of the ECB president. Accounts refers to ECB Monetary Policy Accounts and Interviews to the communication event through interviews of ECB Executive Board members and selected NCB governors. All numbers denote basis point changes. Numbers are rounded to the nearest integer in Panel A and rounded to the second decimal in Panel B.

Table F.9: Importance of events that lead to abnormal returns - FRA

Event	3M	6M	1Y	2Y	3Y	5Y	7Y	10Y
	Panel A: total impact							
ECBGC	362	385	522	762	800	814	694	651
ECB President	24	52	90	194	219	231	264	281
ECB EB	83	140	173	350	480	633	674	642
NCBs	74	99	152	435	467	581	532	555
EP hearing	NaN	23	55	86	95	86	87	83
Accounts	NaN	NaN	3	14	21	19	21	18
Interviews	3	9	11	30	50	58	66	52
	Panel B: impact per event							
ECBGC	5.33	4.14	4.18	5.60	5.52	5.09	4.69	4.29
ECB President	2.21	2.16	2.26	3.12	2.78	3.12	3.11	3.27
ECB EB	2.68	2.45	1.80	2.34	2.39	2.71	2.80	2.99
NCBs	2.97	2.60	2.11	3.45	3.24	3.28	3.21	3.24
EP hearing	NaN	3.80	3.65	3.89	4.31	3.93	3.34	3.61
Accounts	NaN	NaN	1.02	3.44	2.99	3.13	2.58	2.29
Interviews	3.25	2.98	2.64	3.69	3.31	3.88	3.46	3.72

Note: Panel A shows the cumulative impact of absolute surprises for all events with abnormal returns in the French government bond yield, for maturities of three months up to 10 years. Panel B shows the average absolute impact. ECBGC refers to ECB Governing Council monetary policy announcement events. Rows from ECB President to EP hearing, refer to speaking events in the inter-meeting period, from the ECB president, the ECB Executive Board (EB) members, the governors of the national central banks (NCBs) of Germany, France, Italy and Spain, and the European Parliament (EP) hearings of the ECB president. Accounts refers to ECB Monetary Policy Accounts and Interviews to the communication event through interviews of ECB Executive Board members and selected NCB governors. All numbers denote basis point changes. Numbers are rounded to the nearest integer in Panel A and rounded to the second decimal in Panel B.

Table F.10: Importance of events that lead to abnormal returns - ITA

Event	3M	6M	1Y	2Y	3Y	5Y	7Y	10Y
	Panel A: total impact							
ECBGC	63	128	412	958	999	1050	932	895
ECB President	52	77	78	366	369	414	431	412
ECB EB	192	183	272	820	1075	1121	1072	959
NCBs	92	100	191	745	741	908	931	833
EP hearing	NaN	20	36	112	111	119	95	93
Accounts	NaN	1	4	19	22	33	37	36
Interviews	16	3	6	50	56	59	66	76
	Panel B: impact per event							
ECBGC	3.92	3.77	8.57	7.55	7.86	7.50	7.22	6.89
ECB President	5.24	5.14	4.33	5.02	4.73	4.23	4.10	3.85
ECB EB	5.18	4.06	4.39	4.27	4.50	3.88	3.60	3.59
NCBs	4.85	4.00	4.45	5.43	4.52	4.19	4.00	4.02
EP hearing	NaN	10.00	5.98	5.87	5.28	5.40	4.73	4.05
Accounts	NaN	0.75	3.95	2.42	2.42	2.34	2.65	2.96
Interviews	7.84	3.30	2.79	3.87	3.75	3.68	3.64	3.78

Note: Panel A shows the cumulative impact of absolute surprises for all events with abnormal returns in the Italian government bond yield for maturities of three months up to 10 years. Panel B shows the average absolute impact. ECBGC refers to ECB Governing Council monetary policy announcement events. Rows from ECB President to EP hearing, refer to speaking events in the inter-meeting period, from the ECB president, the ECB Executive Board (EB) members, the governors of the national central banks (NCBs) of Germany, France, Italy and Spain, and the European Parliament (EP) hearings of the ECB president. Accounts refers to ECB Monetary Policy Accounts and Interviews to the communication event through interviews of ECB Executive Board members and selected NCB governors. All numbers denote basis point changes. Numbers are rounded to the nearest integer in Panel A and rounded to the second decimal in Panel B.

Table F.11: Importance of events that lead to abnormal returns - ESP

Event	3M	6M	1Y	2Y	3Y	5Y	7Y	10Y
	Panel A: total impact							
ECBGC	117	248	198	743	890	846	813	787
ECB President	6	60	50	274	348	410	438	453
ECB EB	75	224	228	708	832	1060	1077	1011
NCBs	84	102	152	528	619	798	779	809
EP hearing	NaN	7	41	116	141	77	94	75
Accounts	4	NaN	10	8	12	23	31	25
Interviews	NaN	14	14	57	44	68	68	70
	Panel B: impact per event							
ECBGC	5.31	7.07	5.66	6.19	5.90	5.76	5.65	5.28
ECB President	1.41	6.71	3.31	4.42	4.09	3.98	3.68	3.80
ECB EB	4.17	4.38	3.62	4.16	3.50	3.43	3.18	3.15
NCBs	5.24	3.63	3.53	3.97	3.87	3.38	3.42	3.36
EP hearing	NaN	3.65	13.58	5.53	5.42	3.09	3.91	3.76
Accounts	4.40	0.30	2.39	1.60	2.01	1.95	2.18	2.11
Interviews	NaN	7.15	2.86	3.57	3.40	3.25	3.41	3.68

Note: Panel A shows the cumulative impact of absolute surprises for all events with abnormal returns in the Spanish government bond yield, for maturities of three months up to 10 years. Panel B shows the average absolute impact. ECBGC refers to ECB Governing Council monetary policy announcement events. Rows from ECB President to EP hearing, refer to speaking events in the inter-meeting period, from the ECB president, the ECB Executive Board (EB) members, the governors of the national central banks (NCBs) of Germany, France, Italy and Spain, and the European Parliament (EP) hearings of the ECB president. Accounts refers to ECB Monetary Policy Accounts and Interviews to the communication event through interviews of ECB Executive Board members and selected NCB governors. All numbers denote basis point changes. Numbers are rounded to the nearest integer in Panel A and rounded to the second decimal in Panel B.

Table F.12: Importance of events that lead to abnormal returns - ILS

Announcement	FX	1Y	2Y	5Y	10Y
	Panel A: total impact				
ECBGC	100	37	42	54	57
ECB President	38	78	11	21	16
ECB EB	102	169	69	69	39
NCBs	70	59	70	45	51
EP hearing	11	NaN	NaN	NaN	NaN
Accounts	3	NaN	NaN	NaN	NaN
Interviews	5	10	2	NaN	NaN
	Panel B: impact per event				
ECBGC	0.65	3.41	3.47	2.97	3.56
ECB President	0.41	9.73	2.11	5.34	3.91
ECB EB	0.40	12.04	5.75	6.23	4.32
NCBs	0.41	7.31	7.77	4.99	4.26
EP hearing	0.47	NaN	NaN	NaN	NaN
Accounts	0.32	NaN	NaN	NaN	NaN
Interviews	0.48	10.13	2.13	NaN	NaN

Note: Panel A shows the cumulative impact of absolute surprises for all events that abnormal returns (returns). Panel B shows the average absolute impact of the events. All numbers are in basis points and denote basis point changes in the case of the ILS and returns in the case of Stoxx50. Numbers are rounded to the nearest integer in Panel A and rounded to the second decimal in Panel B.